The Electrical World.

VOL. XXIV. NEW YORK, DECEMBER 22, 1894. No. 25.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY, Limited,

253 Broadway, New York.

Established 1874. Incorporated 1889.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 927 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,
in the U. S., Canada or Mexico; other Postal Union countries, $6.

In requesting your address changed give OLD as well as new address.

Established 20 years ago, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the Largest Circulation of any electrical periodical in the world, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation and standing considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

253 Broadway, New York.

VOL. XXIV. NEW YORK, DECEMBER 22, 1894. No. 25.

CONTENTS.

Editorial 635
Electricity Direct from Fuel, by C. J. Reed 637
Dr. Borchers' Gas Battery: A Suggestion, by Legh S. Powell . . . 637
Fly-Wheel Accidents—II, by W. Stuart-Smith. 637
Christmas and Electricity 639
A Practical Method of Measuring Rapid Changes in Current, by Walter E. Harrington 642
Notes on Rotatory Field Motors, by Prof. S. P. Thompson 643
Electrodynamic Machinery—XIX., by Edwin J. Houston and A. E. Kennelly 644
Electrical Power Transmission—V., by Dr. Louis Bell 645
Practical Notes on Dynamo Calculations—XXI., by Alfred E. Wiener 646
Over-Compounded Dynamos in Parallel, by A. F. Hemingway . . 647
The Chloride Accumulator 648
The Foundation of Mathematical Analysis, by Prof. Alexander Macfarlane 648
The National School of Electricity, by Prof. H. S. Carhart 648
Efficiency of Street Railway Generating Plants, by A. C. Balch . . 648
Transformer Testing 648
Digest of Current Technical Electrical Literature, compiled by Carl Hering 649
Magneto Telephone Exchange 652
A Huge Alternating Generator 652
DEPARTMENTS:
Financial Intelligence 653
Special Correspondence 653
News of the Week 654
Trade and Industrial Notes 656
Business Notes 657
Illustrated Record of Electrical Patents 657

BERLINER TELEPHONE PATENT.

The decision in the suit for the annulment of the Berliner microphone patent was handed down in the United States Circuit Court at Boston on Tuesday, December 16. The court decided the patent to be void. The decision is one of great importance as it leaves the telephone field free practically so far as the manufacture and transmitters and receivers is concerned. Had the Bell Company won the suit, it would have secured to itself for a long period of years the continuation of the monopoly of all long distance work. The question not only affects the Berliner patent and the telephone interests, but those who follow the suit will remember that it developed into an indictment of the Patent Office itself, and it is to be hoped that in these days of investigation and reform some good may result from the publicity thus given to the methods of so important a branch of the Government.

STORAGE BATTERY PATENTS.

An official announcement has finally been made by The Electric Storage Battery Company of Philadelphia in regard to the acquirement by it from various sources of the fundamental storage battery patents. As foreshadowed in these columns last week, there is no consolidation of the various interests of the storage battery companies concerned as has been erroneously stated, though the resulting situation is such that there will undoubtedly be a friendly coöperation in the future. The deal consisted in the transfer to the Electric Storage Battery Company of all the patents and patent rights relating to the manufacture of storage batteries that were held by the General Electric, Edison Electric Light, Thomson-Houston Electric, Brush Electric and Accummulator, Consolidated Electric Storage Battery and General Electric Launch Companies. This carries with it the sole right to supply in the United States electric storage batteries of the various important types heretofore developed and includes the protection of the several important decisions rendered in the United States Courts in interpretation of electric storage battery patents. The acquisition of these patents will, therefore, not only terminate the litigation which has heretofore had such deplorable results, but as all of the fundamental patents on storage batteries seem to be now included under one ownership, there is consequently a good prospect that the industry will have the free development which has been denied it in the past. The business methods employed in the past by the company now in control in its management of the chloride battery have been of such a character as to lend further assurance of the accomplishment of this long-deferred hope.

RECORDING MEASURING INSTRUMENTS.

Our esteemed London contemporary, *The Electrical Review*, in the current issue argues in favor of recording testing instruments, and wonders why practical forms of such apparatus have not been brought out. Every one who has done any testing will sympathize with the desire expressed for recording volt, ampere and watt meters for general testing use, but a still greater need is to induce managers of central stations to favor continuous recording instruments for commercial purposes. If investigators do not have recording instruments they will nevertheless manage, though perhaps, with much labor, to obtain satisfactory data, but this is not true as a rule of station managers. One of the results is a general ignorance of the unit cost of operation, and therefore of the knowledge upon which to intelligently judge as to economical or efficient working. It is not sufficient in a central station to require the keeping of a log to include readings of the voltage and current; it is too much to expect that employees will incriminate

themselves or friends by absolutely exact records of the former and the latter cannot approach continuous records in reliability and convenience. Every central station should have a recording voltmeter as a check on employees and a recording meter for the out-put—preferably a wattmeter. In power-houses there is an absolute necessity for a watt-meter if an intelligent check is to be kept on economy of operation, and if they are now only used in isolated cases it is probably due to difficulty in obtaining suitable ones for large stations. We think that a good commercial field is here offered to manufacturers, for the utility of recording instruments in the instances named could, without much difficulty, be impressed upon the managers of central and power stations, and no particular effort, as far as we know, has been thus far made to do this. The letter of Mr. Balch in another column reflects the opinion of intelligent managers, whose desires do not seem as yet to have met with the usual response from commercial sources.

ROTARY FIELD MOTORS.

In an article on "Notes on Rotatory Field Motors", which we reprint elsewhere in this issue, Prof. S. P. Thompson renders another of the services to the electrical public which it has lea ned to expect from him when a new electrical subject beset with difficulties comes to the front. His statement of the theory of the induction motor is not only simple and clear, but couched in terms that correlate it with the well understood theory of the continuous current motor. We think that perhaps if the succession of transformer and motor actions had been explained at greater length, the subject might have been made still clearer. In this connection the simple sketch and explanation due to Mr. Rankin Kennedy, is very effective, which shows how in a two-phased induction motor one of two currents differing in phase induces a current in the closed circuit winding, which current in turn is acted upon by the other pole, producing torque as in a continuous current motor, and vice versa. The explanation given of the way a resistance in the rotor circuit at starting will increase the torque does not seem to us to make the matter as clear as was evidently intended. In the discussion on Lieut. Reber's Institute paper on two and three phased motors, Prof. Pupin referred to this question, and as his method of regarding it supplements that of Prof. Thompson, we will briefly resume it. Starting out with the fact that the torque of the induction motor at any moment depends on the respective values of the currents in the armature and in the field and also on their difference in phase, it follows, that is, if the difference of phase is great, the torque may be small even if large currents flow; this difference in phase in induction motors is produced by self-induction, which may be greatest when the armature is at rest, but if the variation in phase of the armature current can then be reduced by any means the torque will be increased. There are three ways by means of which this can be done—varying the self-induction, resistance or capacity; of these the first is out of the question, and the second, being simpler than the third, is the one adopted. It will be seen that the resistance put in circuit is not primarily to stop the great rush of current, though it has that effect.

DIRECT CONVERSION OF COAL INTO ELECTRICAL ENERGY.

In our issue of July 21st we referred to the statement of Ostwald that the one essential lacking to produce electrical energy by the direct oxidation of coal without heat, is a suitable electrolyte to interpose between the carbon at one end of a cell and the oxygen at the other, which will itself suffer no change while permitting the necessary interactions. In a recent paper, abstracted in the Digest, December 8, Dr. Borchers, a German electro chemist, describes some investigations along the lines laid down by Ostwald. The idea in view was to produce electrical energy by the oxidation in the cold of carbon monoxide by means of atmospheric oxygen, the operation being conducted with cupreous chloride as an intermediary fulfilling the conditions above laid down. The apparatus constructed is equivalent to a gas battery having oxygen and carbon monoxide as the active materials and a solution of cupreous chloride as the electrolyte connecting them, though in one case powdered coal was substituted for the monoxide with theoretical results but little inferior to those obtained with the gas, though the practical difficulties involved in its use were found to be much greater. With the crude apparatus used, an efficiency of 25 to 33 per cent. was obtained, or three times that of the steam engine; it should be added, however, that the internal reactance of the apparatus was so great that but little of the electrical energy was available for use in an exterior circuit. Dr. Borcher's points that a previous gasification of coal is necessary from practical considerations, and that various substances, such as the salts of iron, manganese, cobalt and lead, may also be employed as electrolytes. The conclusion of Dr. Borcher is that, whatever the outlook for the direct utilization of the energy of coal may be, it is at least evident that, by the present method, combustion in the cold can be effected of natural and artificial products of distillation and limited combustion (as natural gas, coke-oven gas coal gas, producer gas of all kinds and blast furnace gas), with the production of electrical energy. Assuming that the problem were really solved, it does not follow, as often asserted, that a revolution in the electrical industry would result. Supposing that the cost of the apparatus and labor were the same as with the steam and electrical machinery displaced, the saving would merely be in fuel, and this item at present, on the basis of four pounds of coal per hourly horse-power, amounts to less than one cent, with coal at $4.00 per ton, per hourly horse-power of electrical energy delivered, the total cost of which quantity of energy is rarely below 8 cents, and is usually sold for electric lighting at 12 cents. If, therefore, the fuel were supplied under these conditions for nothing, and used at an efficiency of 100 per cent., the reduction on the cost of electrical energy to the consumer would not be ten per cent. In the production of electrical energy it should be borne in mind that the fuel is but one item of cost in many, the total including fixed charges, management, superintendence, labor, depreciation, insurance and repairs. The error of regarding only the item of fuel has also led to the popular misconception as to the possibilities of water power as a source of very cheap electrical power. In this case it may easily happen that the saving effected in fuel, labor and machinery is balanced by the charges on the investment for improving the water power, though in most instances, particularly where the water power is an extensive one, favorably situated and not requiring too large an outlay for development, there will be a sufficient saving to justify its use, though it may not result in any notable cheapening of the cost of electrical energy to the consumer. Since writing the above we have received an interesting communication from Mr. C. J. Reed, printed in another column, which attacks the conclusion of Dr. Borchers that cupreous oxide fulfills the conditions of the electrolyte as laid down by Ostwald.

Decimal System of Weights and Measures.

The new Decimal Association of Great Britain, which has been established to promote the adoption of a decimal system of weights, measures, and coinage in the United Kingdom, met recently at the offices of the London Chamber of Commerce, with a large number of distinguished gentleman in attendance. Sir Samuel Montague, M. P., the chairman, mentioned that the association proposed to confine the present movement to weights and measures, and not deal with the subject of decimals in money. Sir Albert K. Rollit, M. P., proposed the following resolution: "That this association learns with satisfaction that the government consents to the appointment of a select committee to inquire whether any and what changes in the present system of weights and measures should be adopted, and the executive committee is hereby authorized to take such steps as it may consider best for promoting the adoption of the metric weights and measures." The motion was seconded by Mr. J. Emerson Dowson, C. E., and after it had been supported by half a dozen speakers, was carried. A further resolution was passed to the effect that the Hon. William L. Wilson should be informed of the present position of the movement in Great Britain for adopting the metric weights and measures, and that he be invited to use his influence to secure such legislation as may provide for the adoption of this system of weights and measures in the United States.—London *Electrical Engineer.*

Electricity Direct from Fuel.

BY C. J. REED.

The recent experiments of Dr. W. Borchers on the direct production of electricity from fuel gases, described in THE ELECTRICAL WORLD Digest of Dec. 8, are not as hopeful as one might think from the erroneous conclusions which Dr. Borchers has drawn from his experiments.

While the doctor is undoubtedly working in the right direction, he has in the experiments described accomplished absolutely nothing. If the doctor will carefully analyize the materials he employs and the products he obtains, he will make another startling discovery. He will discover:

1. That the increase in weight of his copper tubes is due to the formation of a coating of insoluble cuprous chloride, $Cu_2 Cl_2$, produced by corrosion of the copper tubes.

2. That the oxygen absorbed by the cuprous chloride solution does not combine at all with the carbon monoxide or other fuel gases, but is used solely in oxidizing the cuprous to cupric chloride according to the following equation.

$$O + Cu_2 Cl_2 + 2H Cl = 2Cu Cl_2 + H_2 O.$$

Cuprous Chloride — Cupric Chloride

The ultimate and only product of the reaction is cupric chloride produced at the expense of the copper tubes.

3. That the energy evolved as electric current is due to this corrosion of the copper tubes and to nothing else.

4. That the same results would have been obtained by his apparatus if he had not used any gases at all.

If the reactions supposed by the doctor to have taken place did actually occur, they would occur in the same manner with both electrodes of carbon and there would be a continuous evolution of carbon dioxide.

Even if the reaction did actually take place, the arrangement would be of no practical value, as the cuprous chloride, $Cu_2 Cl_2$, rapidly change in the presence of air *by the absorption of oxygen* to cupric chloride, $Cu Cl_2$. which would have to be continually reduced by metallic copper or an equivalent reducing agent. In that case an ordinary zinc primary battery is more economical than a copper battery.

The writer tried about a year ago the same experiments described by Dr. Borchers, using carbon tubes for both electrodes instead of copper. Over one hundred different solutions, including cuprous chloride, were tried as electrolytes. I was unable to find that any two gases would combine spontaneously under these conditions unless they were capable of combining spontaneously at low temperatures when brought in contact with each other in the gaseous state.

Electrolytic gases formed at the electrodes by an electric current will recombine. But I was unable to get positive evidence of combination of even oxygen and hydrogen obtained from other sources and free from ozone and other impurities.

Dr. Borchers' Gas Battery: A Suggestion.*

BY LEGH S. POWELL.

Dr. Borcher's recently described experiments on the direct conversion of carbonaceous fuel into electrical energy are most interesting. In this connection it occurs to me to be worth while suggesting, through your medium, that the carbon electrode which is exposed to the air might very probably be rendered more efficient in performing its allotted work if it be exposed for a short time to a red heat in presence of air, so as to slightly burn its surface. The following experience leads me to make the suggestion:

Some twelve or thirteen years ago whilst amusing myself with making home-made batteries, I made the discovery that an excellent depolarising electrode might be made by filling a muslin bag with ordinary fire-grate cinders, placing a stick of arc carbon in the middle to serve as a terminal, and finally binding the whole tightly together with a string or elastic. Such an electrode when placed in common salt and water, with a strip of sheet zinc in proximity, will ring a bell continuously for days and weeks. But, it is significant to mention, if bits of coke or any other form of carbon (not previously exposed to a red heat in air) be substituted for the cinders, the electrical effect obtained under the same conditions of quantity, size, etc., is poor in the extreme. The effect obtained with different descriptions of carbon varies, that with coke being especially poor, whilst the carbon obtained by "baking" cocoanut shells answers much better; but nothing approaches that obtained with common grey cinders, whether produced from either coal or coke. In the case of coke, there seems to be a badly conducting film covering the true carbon, and the same is the case with carbon rods, which should be either scraped or have the surface burnt before introducing into the bag of cinders.

The cause of the remarkable difference in the behavior of burnt and unburnt carbon was at first thought to be due to the reduction of some oxides which had been formed during the burning, and that the action was similar to the Leclanche principle. But I soon satisfied myself that the real cause of the difference was principally, if not entirely, due to the simple circumstance of an increased superficial area. Not only is the indifferently conducting film on the surface of the carbon removed by burning, but it is obvious that the probing action of the heated air into the pores of the substance must lay bare and render accessible to the electrolyte a vastly increased quantity of carbon to that originally presented. The hydrogen deposited by the electric action will thus become distributed over a considerable area, and be more readily burnt up by the occluded oxygen in the carbon. That this is the explanation may be prettily demonstrated by taking two exactly similar sticks of arc carbon—a form of carbon in which metallic impurities cannot be called into question. Expose one of them for a short time to a red heat in a blow-pipe or in a fire, and scrape the other with a file. Then make up two similar cells of salt and water, and zinc strips. Each of the diminutive cells will ring a bell at the start, but the one which has not been heated will cease to ring it in about 15 or 30 seconds, whereas with the other the bell will go on ringing for two or three minutes. When run down the battery will recover its strength by a period of repose, and, as might be expected, the recovery in the case of a burnt carbon takes place much more slowly than with the unburnt, for the quantity of hydrogen to be consumed in the former is naturally greater than in the latter. This latter circumstance also goes to prove that extent of surface is the main feature at work rather than some special property of occluding or consuming the gases. It may be mentioned, however, that in a rough experiment made with a burnt and an unburnt plate of carbon used in a bichromate cell, no appreciable difference in efficiency was observed. The conditions here, however, are materially different. For the salt and water cell, or other similar electrolyte, there is every reason to believe that the hydrogen appearing on the carbon is consumed at the expnese of oxygen occluded from the air by that susbtance, and that the action does not appertain to the Smeed type of cell. Therefore, as stated at the outset, it is quite possible that for the purposes of Dr. Borcher's fuel battery the plan of increasing the interstitial carbon surface by the simple means described may prove to be advantageous.

Might not a further improvement in electrical effect be perhaps obtained by applying pressure to the respective gases used? I have long wanted to try the effect of pressure of air and oxygen on my cinder battery, to see if there was an improvement in constancy and output, but have never had the time and opportunity to try the experiment.

*From the London *Electrical Review*.

Fly-Wheel Accidents—II.

BY W. STUART-SMITH.

To determine whether the bending moment acting in the middle of the span is sufficient to cause rupture, it is necessary to consider the *moment of resistance* or the maximum strain which any given section is capable of withstanding. The outer layers of the rim will be lengthened and the inner layers shortened under the bending action; hence rupture will take place by tearing apart the outer layers and crushing the inner layers, while along the neutral plane the force will be shearing only and acting at 45 per cent. This is of no importance under the circumstances. The resistance of the material to rupture will be greater than the tensile strength and less then the resistance to crushing, the exact amount depending upon whether the greater portion of the section is to be ruptured by tearing or crushing, and this in turn depends upon the figure or shape of the section. For a rectangular solid section, the metal of which has a tensile strength of about 20,000 pounds, the modulus of rupture for cross breaking will be about 40,000 pounds. The moment of resistance to cross breaking is in general expressed by $M = ufbh^2$. Where f is the modulus of rupture, b is the breadth and h the depth, u is a factor depending upon the shape of the section; it has a value of one-sixth for a rectangle. These formulæ for maximum bending moment and moment of resistance are easily deduced and their origin need not be considered here.

With the data now at hand it is easy to determine at what speed the wheel assumed must be driven (provided it is perfect in all parts) in order that it may be destroyed by centrifugal force. The moment of resistance $= ufbh^2 = 1.6 \times 40{,}000 \times 50 \times \frac{3}{25}$ (all dimensions being expressed in inches) $= 4{,}083{,}333$ inch pounds.

The maximum bending moment has been shown to be 438,900 inch pounds, hence to wreck the wheel the centrifugal force must be increased $\frac{4{,}083{,}333}{438{,}900} = 9.3$ times, which (since centrifugal force increases as the square of the speed) means that the wheel will be wrecked if the speed comes to three times its normal value. As wheels are never perfect and may contain blow holes or be spongy in the middle of the span, wrecking would generally occur at a considerably smaller speed than this.

The above is on the assumption that the arms are strong enough to furnish rigid supports that cannot give way under any stresses that may be placed upon the spans. If this is not the case, and the arms are liable to give way, the speed required for destruction will be much reduced, and an examination of this question will be in order.

Consider the part of the rim included between three areas. The curvature will not be so great but that the formula for greater bending moment for a straight span will apply with some degree of approximation. The span will then be of double the length and the arm in the center will act as a tie resisting the bending of the span. The length of span being doubled and the centrifugal force being doubled, the greatest bending moment will be increased four times and its point of application will be at the tie. It is evident then that the tie (*i. e.*, the arm) will be subjected to a considerable tensile strain, and its tensile strength must be added to the moment of resistance of the rim in order to determine the total resistance to rupture at this point. Assuming the least section of the arm to be 48 sq. in. and the tensile strength 20,000 pounds per square inch, the total strength of the arm will be 960,000 pounds. This, added to the moment of resistance to cross breaking will give a total of 5,043,333

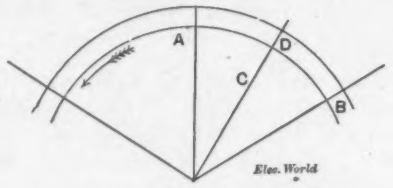


FIG. 2.

inch pounds. The bending moment being four times that previously found will be 1,755,600 inch pounds, and consequently the ultimate strength of the rim and arm is but 2.9 times the working strain normally thrown upon it. Certainly a small factor of safety and one overcome by a speed of 1.7 times the normal. As the consideration of one span only gave a factor of safety of 9 it is evident that when a wheel is worked by centrifugal force the inertial break may be expected to occur at the smallest part of an arm, and that this will be followed by a fracture of the rim immediately alongside the stump of the arm left on the rim. The fracture of the rim will occur at that point, because the bending moment will here be nearly at a maximum, and the moment of resistance much less than through the thicker metal at the point of exact maximum bending moment.

From these considerations it should be easy to determine by a post mortem examination whether or not the wheel was wrecked by centrifugal action.

If the arms have but 24 inches cross section instead of 48, as assumed above, the ultimate strength will only be reduced from 2.8 to 2.6 and it is evident that it is only necessary to put in the arms as much metal as is required for driving, and to increase the resistance to centrifugal force by increasing the thickness of the rim. Retaining a rectangular section, doubling the thickness of rim will double the centrifugal force and the bending moment, but it will increase the moment of resistance four times, since this varies as the depth squared. Also with a given weight of rim the strength will be increased by using a T section, thereby increasing the depth.

If from some flaw in the rim it breaks between two arms, the conditions will be changed and the remainder of the span now becomes a beam supported at one end and uniformly loaded, with the greatest bending moment near the arm. If this piece does not break off, the beam may be considered as extending forward o the next arm, and the resulting span will have a great leverage and a tie near the outer end. The result will be a strong tendency to break the arm by tensile strain at the smallest section. This arm being thus broken the same might happen to the next, etc., the rim in the meantime breaking into pieces as the arms broke and increased the leverage on the rim. This would account for such a case as that mentioned by Prof. Flather, where all the arms of a wrecked wheel were found to be broken close to the rim.

Where a wheel is running at speed (and performing the office of a fly-wheel only) there is practically no transverse strain on the arms. The rim is subjected to shearing and cross breaking strains (but no tensile strains), and the arms to tensile strains small in amount normally, but very severe when the speed is such that the moment of resistance of the rim is nearly reached.

When the wheel is at the same time a fly wheel and a driver, the conditions are very different and the stresses much more complicated. The arms and rims are subjected to the same strains from the action of centrifugal force, and in addition the arms are subjected to a transverse strain due to the driving force being transmitted through them. Those portions of the rim not under the driving belt are subjected to the full force of the centrifugal action, but when they pass under the belt this is largely neutralized by the belt pull, which tends to collapse the wheel. The centrifugal force may be entirely ovecrome by this and the load on the rim instead of being from within it may be from without or practically zero in either direction; then an instant later the action will be from within, and this applying and removing of the load will occur 100 times per minute with a working of the rim back and forth. It is needless to say how much more severe these strains will be than would be the case if the load was continually applied. Thus from this c use alone a fly-wheel acting as a driver is far more severely strained than would be the same wheel acting as a fly-wheel only. But this is not all. In addition to the bending moment, which was shown above to be constantly acting on the spans, the driving force will produce a further bending moment tending to break the wheel at the same point as that due to centrifugal force. This is easily shown. Let A, B and D, Fig. 2, be three adjacent arms. With the wheel moving in the direction of the arrow the power applied to arm at B would be transmitted to A through the curved arch of the wheel and hence at the middle arm D the binding moment due to the driving power transmitted from arm B will be the pressure at B, multiplied by the arm CD, or the height of the arch of the neutral layer of the rim. This will be applied at D in precisely the same manner as the bending moment due to centrifugal action and must be added to it to get the total bending moment. The amount of this increased bending moment is readily calculated for any given wheel. To determine the pressure acting at B it is not sufficient to use the horse-power transmitted by its wheel. That would give the average pressure from which would be obtained the average bending moment, but it is the maximum bending moment that is effective and this is to be obtained by using the pressure at B, when the engine is exerting its maximum turning effort.

The data which was assumed in the previous calculations are very close to those of an actual working wheel, and it was seen then that increasing the speed 60 per cent. would be sufficient to break the wheel if it was perfect in its construction (not necessarily in design), *i. e.*, had no blow holes, was not spongy, had no shrinkage strains, etc. When it is seen in addition how much more excessive the strains will be when the wheel is used as a driver, the fact will be appreciated that many wheels are working just within the limit of safety and it will not seem surprising that they go to pieces. Many wheels must be working within such narrow limits that the variations of load will so weaken them that they may go to pieces under ordinary working conditions and not even the assumption of an application of a shock or increase of speed is required when seeking for an explanation.

This article deals only with strains, the amounts and methods of application of which can be easily predetermined and points out how the rims must be modified to enable a given amount of material to offer the greatest resistance. Wheels have in addition many accidental weaknesses, but they have been so thoroughly considered in the excellent paper by Prof. Flather that nothing need be said about them except that it is scarcely possible to guard against all of them, and they must be allowed for by extra factors of safety and a change in the material used in construction.

Electricity from Water Power.

In Switzerland 52 per cent of the electric generators are driven by water power; as coal is expensive there and water power is cheap, this ratio will doubtless become still greater.

EVERYTHING along the avenues of trade is redolent of the pirit of Christmas tide. The signs of the times, and of course they are electric signs, show that the great day is at hand. On house tops, on store fronts, in the theatres, in the churches, the glow of the incandescent lamp is to be seen, spelling out names and legends, or forming queer devices and decorations. New York, particularly, is outshining herself this year. It certainly is a triumph in decorative effect. That suggestive locality—sacred to Pantatas—the Tenderloin, is bright enough at all times, but just now it fairly reeks of light. Looking southward along Broadway from the "L" station at Thirty-third street, inummerable specks and streaks of flame shine out as though it were meant to be the route of a great truimphal procession.

Many of the signs are permanent arrangements, of course, but many more have been erected in honor of the holiday season. The section known as the shopping district is especially attractive in window shows whose best drawing card is their electrical effects. Electric toys are on sale in the toy shops, Christmas plays with electric effects are to be seen in the theatres, and in fact there seems be a decided and general adoption of the current as a means of furthering the season's cheer.

Of all the special Christmas decorations there is none perhaps which goes so far into expensive elaborations of detail as that of H. C. F. Koch & Co., on 125th street. It was brought to perfection under the direction of Mr. F. W. Campbell, who signs himself the "champion window artist of New York and Brooklyn." Koch & Co. make a specialty of handkerchiefs, and these are made the background for the series of views on exhibition. There are 7,676 'kerchiefs in the window and they make a particularly snowy looking frame which sets well with the season. There are thirteen scenes. The central and largest is the Trocadero Palace, of Paris, done in miniature. The magnificient water stairway is admirably reproduced. The statuary is the same as the original, with one exception—a large bronze Goddess of Liberty stands in the centre of the scene. Streams of water start from the statues, from pipes and jets. They cross and recross each other and roll down the stairway and over the stones shining and glistening from the light of miniature incandescent lamps. The tall columns of the Trocadero show off well behind the water foreground or through the central fountain, which is a real McMonnie in pattern.

One scene represents a storm at sea. There is a wreck and the life-savers are at work. On shore is a small-sized lighthouse with an imitation revolving light which flashes out at regular intervals. The tenement house fire scene gives scope for some nice little electrical effects. By means of colored globes and an automatic interrupter the fire becomes quite lurid and the hose company at work quite realistic.

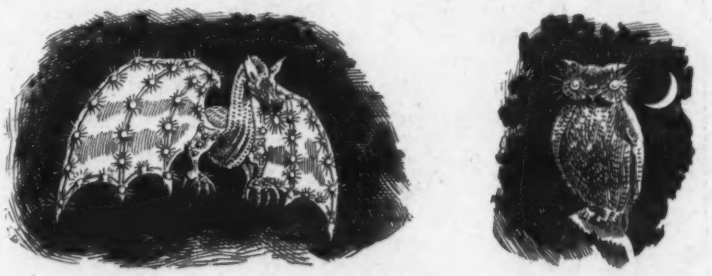
"Dante's Inferno" is also well equipped from the electrical standpoint. Perhaps it is not an exact representation of the place where the great poet sent many of his enemies, but it takes with the "gallery," which, in this case, is the sidewalk, and when the light flashes through its gloomy caverns, makes a great hit. So does the "Druid's Temple," from Killarney Lakes, which is lighted with miniature lamps so as to give a moon effect. "Niagara Falls" is represented with real water flowing over the precipice and lighted from behind. It is quite realistic. There are two scenes from Rip Van Winkle, one where Rip meets the dwarfs and one where he awakes from his long sleep. Van Cortlandt Park on a winter night is represented covered with skating parties. There is an "Eastern war scene," a "private deer park" and a view of the West Point parade ground, surrounded by water, on which sail the caravels of Christopher Columbus. Still another scene represents icebergs near Kosoak.

The whole display cost in the neighborhood of $2,000. The electrical part of it was constructed by Mr. R. Kyle, the resident electrician. The wires are all covered with rubber tubing. The temporary equipment of the window consists of 50 lamps (Edison 16-cp) divided into 16 footlights, 10 border-lights and the remainder within the spaces to add to the scenic lighting effects. Messrs. Koch & Co. have a T.-H. plant of their own with a capacity of 1,200 lights. There is also a chloride accumulator installation of 78 cells, which is used at night when the place is being cleaned and the ordinary power is cut off.

Williams & Co., at Third avenue and 125th street, also have a window Christmas scene in which Kris Kringle plays a prominent part. The old gentleman's workshop is lighted with incandescent lamps, as is also the house down whose chimney he disappears from the view of the crowd of children on the sidewalk. The Manhattan Electric Company has the contract for lighting his abode.

Macy & Co., at 14th street and Sixth avenue, exhibit a panorama showing all the wonders of the Arabian Nights. The figures are in wax and move on a platform. The lighting effects are obtained from the permanent plant.

A collossal figure of Santa Claus, Kris Kringle, or St. Nicholas, whichever you may like to call him, stands exposed on a balcony of Madison Square Garden, and serves to advertise the "Toy Fair in Nuremberg" now running in the Garden. Even his eyes are lamps and they also act as the buttons on his coat. He has two big Christmas trees with him studded with 32-cp lamps, while in front of him is a powerful reflector and several 32-cp lamps, which serve for general illumination. He is a pleasant foretaste of the sights the children see inside. There is an intent look in his electric eyes which gaze off through Madison Square. Perhaps it is caused by an immense flaming legend which covers the side of a house at the southward—"Paul Jones' Pure Rye Has No Equal." This sign used to tell of building lots that were



SEEN ON BROADWAY.

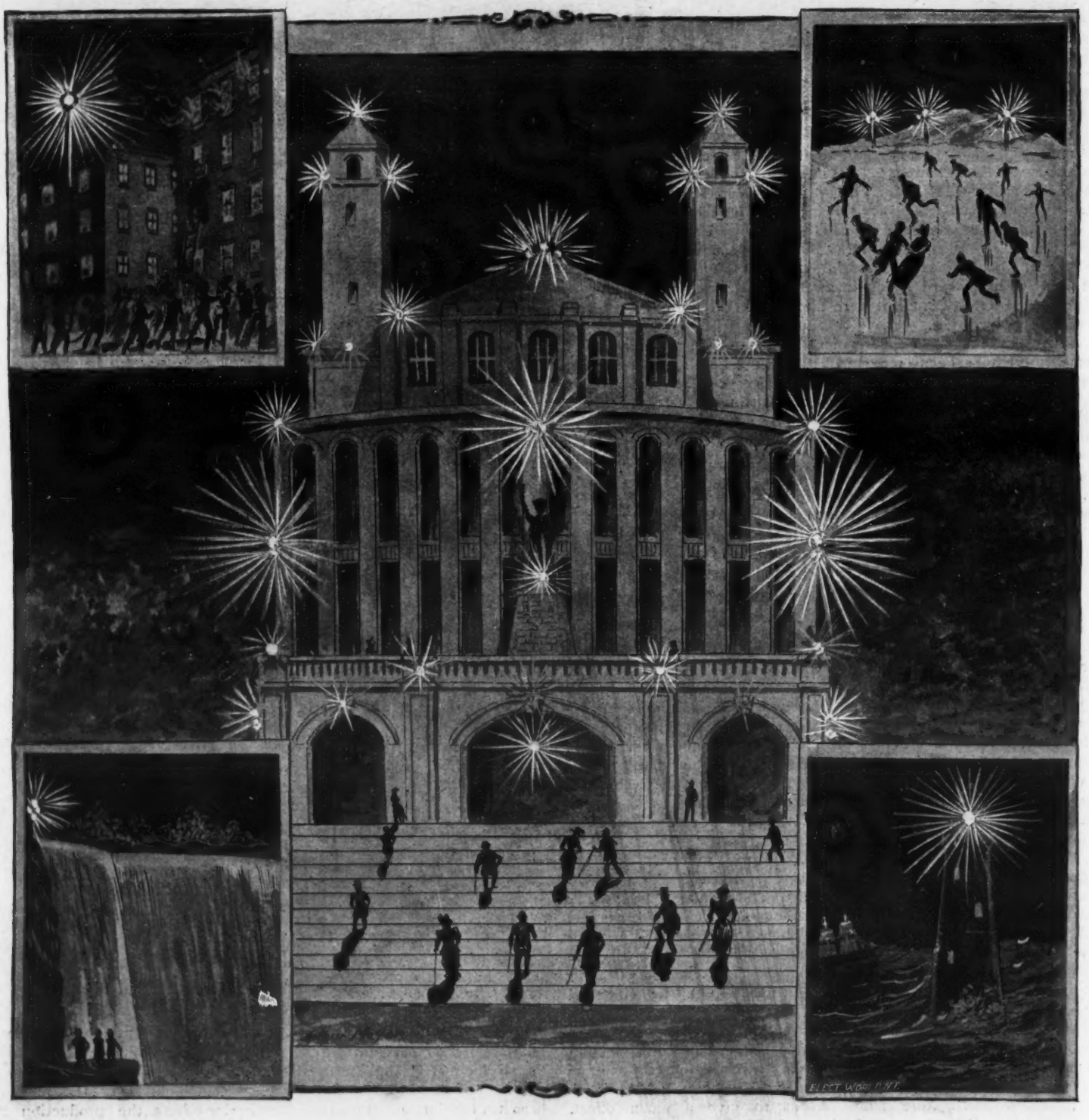
swept "by ocean breezes." It is the largest electric sign in town.

The "Brownies" at the Fourteenth Street Theatre furnishes abundant opportunity for electric effects. The attraction is in large measure spectacular and like all spectacular productions depends mostly for its lighting effects on electricity. Brownieland is a new domain and almost any innovation in the stage effects of the play becomes legitimate. Outside of the regular effects, the production has several new contrivances. In the first act is a scene in which the Brownies are represented adrift on a raft in mid-ocean. A terrible storm is raging. The little people have gone to the rescue of their Queen, who has been spirited away by the wicked demon Dragonfel. In the midst of their trials a terrible sea serpent, with eyes and mouth of fire appears and threatens to devour the whole band. At the critical moment, Neptune, the god of the sea, arises, quiets the waves and saves them. Neptune, of course, appears riding on his traditional sea shell, and by means of the calcium and

several bunchesof electric lights behind and in the shell hisappearance is made very effective. The sea-serpent's eyes are made of 16-cp blue lamps, while a 16-cp red lamp makes a very vivid and fiery tongue.

The Brownies finally land on the enchanted island of Dragonfel. The scene is one of the prettiest in the play. The castle is in the natural rock formation and reminds one of Gibraltar. The niches, windows and crannies in the rock shine through the darkness, for it is night, and the Brownies are on shore playing a serenade to the moon on illuminated mandolins. From a large branch of a tree hangs a line of enormous apples. Eyes, a nose, and a mouth, are cut in each, and lamps inside light them up at intervals. A solitary owl with blinking, incandescent eyes, guards the serenading band whose efforts are so rewarded that the man in the moon speaks to them and guides them in their search for the princess. The mechanical arrangements are simple. The castle is lighted by bunches of lamps from behind. The apples five in number, have, as intimated, a 16-cp lamp inside. The owl's eyes, which are "winked" by snapping a switch at the board, are miniature lamps of one or two candle-power. The mandolins have a 16-cp lamp inside and trailing wires to each allow the players to walk around at will. The moon, which is on a flat, is lighted from bunches. Finally the man in the moon gets tired and goes to sleep. A night-cap with *Good-Night* shining on it begins to appear on his head and he sinks on the horizon and finally disappears.

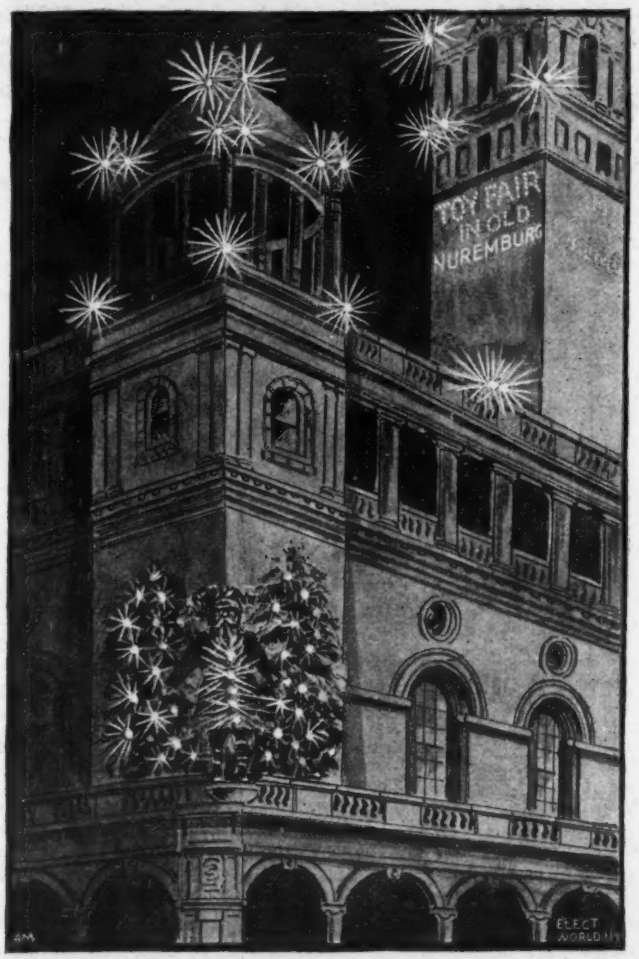
The interior of Dragonfel's castle is a marvel of scenic effects, and so is the scene when the castle is destroyed by volcanic eruption, but the "Jeweled Mines" scene has more real electrical effect in it. The walls of the mine are made of tinsel paper and cloth, and besides are covered with metallic protuberances that reflect a great deal of light. At various points the walls are studded with "jewels" made of colored glass. Back of these little windows are powerful bunch lights which project gleams of light through the jewels is a very realistic manner. At various points on the front of the walls are red, blue and white lamps in miniature. They look like jewels and add much to the general effect. The Edison system is used, each section of scenery being plugged on to a socket in the stage



Details of a Harlem Show Window Decoration.

floor. The flashing is done at the switchboard by snapping the bunches in and out.

The last scene in the play shows a night in Brownieland, with "blossoming of the Moon-flower and Night-blooming Cereus." An "Aerial ballet" is also shown, in which some of the dancers actually move around in air. The scene shows a glen. There is a waterfall and stream, and running water with miraculous flowers blooming by the side of the brook. The running water and the waterfall are made with an ordinary "ripple" on a flat scene with concentrated bunches behind. The Moon-flower has lamps concealed within it, and as it blossoms the leaves turn back and the stamens in the form of filament lamps rise out of it. Lamps are concealed in the shrubbery and among the rocks and a row of lamps in a pool of still water makes the latter very effective. In the "aerial ballet" the dancers are suspended from above on wires. The lighting effects are obtained by means of four arc "calcium" lights—two in the orchestra and two in the wings. Transparencies in front of these allow of various combinations of colors to be thrown on the girls' dresses. Mr. R. H. Francis is the electrician in charge. The theatre has an Edison switchboard



AT MADISON SQUARE GARDEN.

and current is obtained from the street circuit. The production shows how necessary electricity has become to the spectacular play.

By far the biggest theatrical attraction of the year has been the "Living Pictures" at Koster & Bial's. And if any one thing in the theatrical line has depended on electricity more than another for its production, it is these living pictures. As nearly all the world has seen them by this time, only the Christmas element in them needs mentioning. Koster & Bial have put on a seasonable picture in the form of a reproduction of the famous "Christmas Eve" by Operti. It will doubtless be very much admired, as the original is well known, and resident electrician Charles Menlenbergh will have added another to his triumphs in electrical lighting.

The Church of St. Francis Xavier, on 16th street, is, electrically speaking, one of the most elaborately lighted churches in the world. The Italian Renaissance style of architecture is well adapted to electrical decoration. There are nearly three thousand lamps scattered over the church edifice. The altars are covered with decorative effects, symbolical and otherwise; around the sides of the church are all kinds of devices composed of lamps; the statuary is lighted electrically; the pulpit has its equipment and altogether the Order of Jesuits seems to have departed very far from its professed simplicity of method and purpose when it allowed its church to be so elaborately equipped. It is only on stated occasions that the church is completely lighted, but at Christmas time every lamp will be on, and several special devices will be used. The most beautiful device in the church to be used this Christmas is the lighted column and vase of lilies. The column is of alabaster, three feet high and one foot in diameter. It is hollow and on it stands an alabaster vase with porcelain lilies springing from it. Incandescent lamps form the stamens of the lilies and in the

THE FIERY DRAGON—FROM "THE BROWNIES."

vase and the column are concentrated bunches of lamps. When the current is turned on, the lilies and vase and column light up, showing all the tints and veins in the stone. The decorations were designed and installed by Mr. D. Colombani, formerly connected with the Edison Electric Illuminating Company.

New York is rapidly becoming a tower lighted city. A view from the roof of a tall building discloses a large number of illuminated steeples and cupolas shining up through the darkness. Some are permanent effects, others have been equipped as holiday attractions. One of the prettiest which will be lighted on Christmas night, is on Geo. Ehret's Hell Gate Brewery on the upper east side. It is a pointed tower and from the apex to the base are strung four long rows of 16-cp incandescent lamps. On each side of the tower the

THE ENCHANTED ISLAND—FROM "THE BROWNIES."

monogram of the firm shines out. The figures 1866—1894 on the front of the building, show how long the firm has been in existence. On the top of the tower is an eagle which serves for a weathervane. In the eagle's mouth is a 50-cp lamp. A sliding contact arrangement under the eagle allows the lamp to remain lighted although the bird turns with the wind. There are also four 50-cp lamps stationed just below the eagle. There are seven hundred and fifty 16-cp lamps on the tower. The generating plant

consists of two No. 16 Edison dynamos of 350 amperes capacity each. Everard's Brewery, on the Harlem River, also has an electrically equipped tower which will be illuminated during the holidays. The Everard clock is known far and wide and Harlemites always set their watches from its face. Of course the *World* dome will be lighted up, as Madison Square always is. As intimated Broadway is in a blaze of light and several temporary signs have been erected in front of the stores and theatres. The Empire Theatre has an immense arrangement done in opalescent Edison lamps which are made to spell "Masqueraders," the name of the play running there. At Abbey's, where Lillian Russell is singing, is another sign, a "written" arrangement, which tells that here is to be found the present "Queen of Brilliants." The American Theatre has two huge signs on the roof and two more over the doorways, and the Hotel Marlborough is similarly bedecked. At the new Herald Square, which used to be the Park, the words "Rob Roy" and "The Whitney Opera Company," stand out in light. The theatre itself is ablaze. Beneath the eaves of the roof is a row of apertures or cornices. Each one contains an opalescent lamp. The portico is similarly provided for and both rows extend completely around the building. In the middle of Herald Square stands the Herald Building. All around the edge of the roof stand the Herald owls—twenty-six night birds on guard, their eyes blinking out the hours and half hours. The eye of each owl is an incandescent lamp, the current to which is automatically interrupted with the stroke of the clock.

Koster and Bial spell their names with incandescent lamps and so does Fanny Davenport, who is playing "Gismonda" at the Fifth Avenue Theatre. The Standard Theatre and Hoyt's Madison Square follow suit. Augustin Daly has added a row of incandescent lamps to his theatre portico. "Old Hoss, Bill Hoey," shines out at the Bijou, and "Comstock's Minstrels," in hundreds of miniature incandescent lamps, is a feature in the decoration of St. James Hall.

The stores, too, have their decorations. Thorley, the florist, believes in the advantage of making a good show and intersperses his plants with incandescent lamps. His name, in large spencerian letters, in lamps, is above the door. Any one who passes Hilton, Hughes & Company's store will be pretty sure to stop and look twice at the wonders displayed in the windows, not because of the articles themselves, but because of the way in which they are set off. Here are probably the best lighted windows in town. The principle, or arrangement, of the lighting effect, is the best possible under the circumstances. Every object displayed rests under a perfect glare of light, yet not a lamp is to be seen. The hundreds of lamps in the windows are attached in rows around the edges, or more properly, back of the window frames, above and below, and at the sides.

In running up the list of electrical Christmas attractions one peculiar fact has been elicited. There is quite a demand for electrical toys, and while one or two playthings are sold, yet there is no really good electrical toy on the market. Toy dealers say that there would be a good sale for an attractive article but it is impossible for them to get one, because capable electricians will not give time to the invention of what is an apparently trivial object.

This about completes the list of Christmas attractions in electricity. The list is long enough, however, to show what a potent factor the electric current has become in furthering the season's cheer.

A Practical Method for Measuring Rapid Changes in Current.

BY WALTER E. HARRINGTON.

Frequently cases arise when it is desirable to know the current that flows in a circuit due to sudden changes in condition.

Ammeters never indicate and further cannot act as an index to sudden changes in current, as the movement of the needle depends upon a number of factors, viz: The moment of inertia of the needle and that of the pointer or moving system; the moment of the controlling force, that is, the forces which resist the needle moving away from zero position, and which tend to pull it back to that position; the moment of the forces that "damp" the vibrations, that is, the forces due to air or "magnetic friction" that simply resist the motion of the needle; lastly, the moment of the deflecting forces exerted on the needle by a given constant current flowing through the coil.

W. E. Ayrton gives as a practical formula to use with a ballistic galvanometer (such as is used for measuring sudden changes) the following:

$$K = \frac{P A \sin\left(\frac{\alpha}{2}\right)}{\pi \tan \alpha'}$$

where K = number of coulombs that pass;
P = periodic time of vibration of needle;
A = amperes which flowing through the coil causes an angular deflection α';
α' = angular deflection of needle due to amperes flowing through the coil;
α = angular deflection due to discharge of K coulombs;
$\pi = 3.1416$.

This formula bristles with uncertainties, and with the formula given as a correction for "damping" we are still further enshrouded in vague and uncertain darkness; the formula for correction for "damping" is

$$K = \frac{A P k}{2 \pi \alpha'}\left(1 + \frac{l}{2}\right)$$

where l is the "Naperian logarithic decrement."

When readings are taken of small values with fine and carefully calibrated instruments and great care is exercised, the ballistic galvanometer method is correct but exceedingly tedious.

The determination of instantaneous values of currents may be appreciated when we look up the literature of the subject. Dr. Bedell in a paper in the *Transactions* of the American Institute of Electrical Engineers, Oct. 1893, on "Hedgehog Transformers and Condensers" mentions some 20 investigators using an instantaneous contact method, among whom are such names as Joubert, Nichols, Morton, Ryan and Duncan.

Where many readings are to be taken of small currents or potential differences the method as described in "Notes on wiping contact methods for current and potential measurements" by Prof. B. F. Thomas in the *Transactions* of the American Institute of Electrical Engineers May, 1892, is unquestionably one of the most easily applied and rigorously correct of the methods practiced, as it is a "null method." Referring to the diagram, R is a resistance

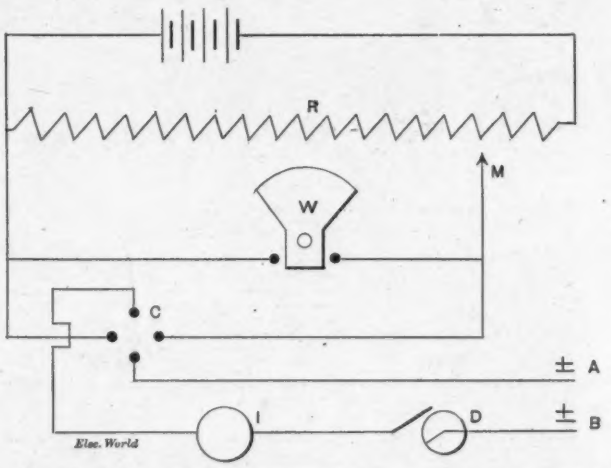


FIG. 86.—DIAGRAM OF E. M. F. INDUCED IN ARMATURE COIL.

of some convenient form, with which contact may be made with a movable terminal, M, or which may be varied between or beyond the terminals of a Weston voltmeter W. From these terminals wires lead through a commutator C, a sensative galvanometer or telephone I and the wiper D to any points A B, whose potential curve is desired. The whole being in operation and C properly placed, M or R (or both) is adjusted until I shows no current, when the potential difference existing at A B is read off directly in volts by the voltmeter W

When it is desirable to read rapid flows of heavy currents, a method that is inexpensive and easily applied has been needed. The writer, after trying different methods finally adopted the following, owing to its simplicity and positiveness.

A magnetic circuit breaker was employed which could be sensitively adjusted to open on different currents within its range, and which could have its time element of opening the circuit inversely proportional to the current causing the opening.

By changing the adjustment of the magnetic circuit breaker until opened by the current, and also until not opened by the current, and by bringing these two points to two consecutive adjustment indications, they give a means for determining the current, as the current would lie between the two indications as obtained.

A magnetic circuit breaker was used by the writer giving an exceedingly fine range of adjustment, and which was very rapid in opening the circuit, thus obviating the vicious arcing attendant upon the opening of circuits with other forms of magnetic circuit breakers.

Notes on Rotatory Field Motors.*

BY SILVANUS P. THOMPSON.

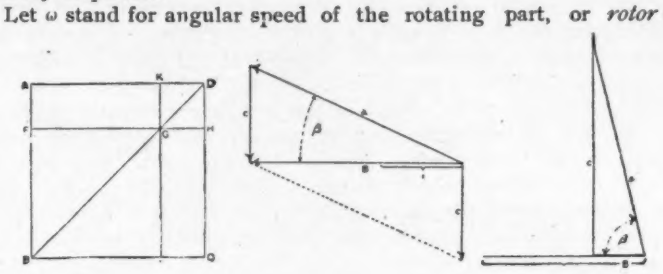
The following notes, compiled for the use of students at the Technical College, Finsbury, are printed as being probably of service to others in aiding their comprehension of the operation of this little understood class of machinery.

1. Elementary Theory of Rotatory Field Motors.

It is assumed that a rotatory magnetic field can be produced in known ways by the proper combination of polyphase currents, whether 2-phase or 3-phase. It is desired to know the relations between the speed of revolution of the magnetic field, the speed of the revolving part of the machine, the torque, and the efficiency of the machine.

Let Ω stand for angular speed of the rotatory magnetic field $= 2\pi n$ in a bipolar machine, or $= 2 \pi n \div m$, where m is number of pairs of poles if the machine is multipolar; and n for the frequency of period.

Let ω stand for angular speed of the rotating part, or *rotor* of



FIGS. 1, 2 AND 3.

the machine, $= 2\pi n_2$, where n_2 is the actual number of turns per second; (or $2 \pi n_2 \div m$ for a multipolar machine).

Let Q stand for the torque between the fixed part (or *stator*), and the turning part (or *rotor*).

Let W stand for the power (total watts) communicated by the stator to the rotor.

Let w stand for the power (useful watts) actually used in turning the rotor.

$\Omega - \omega$ is the *slip* of the rotor with respect to the field, or is the difference of their angular speeds. If the field has an angular speed $\Omega - \omega$ greater than that of the rotor, it is clear that the inductive action on the circuits of the rotor will be exactly the same as if the rotor were revolved backwards with a speed $\Omega - \omega$ while the field stood still.

$W - w$ is the power wasted in heating the conductors of the rotor, since it is the difference between the total power supplied to the rotor and the power it utilizes. Now W is proportional to Q and to Ω, and, therefore, by choosing suitable units may be written $W = \Omega$. And w is proportional to and $Q\omega$, and may be written $w = Q\omega$.

Hence, dividing the last equation by the preceding,

$$\frac{w}{W} = \frac{\omega}{\Omega}$$

From this we see that the efficiency of the rotor is the same as the ratio of the two speeds.

Further, the rotatory field motor is simply a sort of running transformer, of which the stator and rotor windings constitute respectively the primary and secondary. Now, if ω were made $= \Omega$ there would be no induced currents in the rotor conductors, the stator would then simply act as a choking coil; hence it follows that if the condition of supply of the primary currents is that of constant voltage, the magnetic flux through the machine, rotating with speed Ω, will have an approximately constant value at all loads, just as the flux in the core of an ordinary transformer has. Further, if there is very little magnetic leakage in the gap between stator and rotor (as is, indeed, the case in well-designed motors) neither the primary circuit nor the secondary circuit will have any appreciable self-induction, and the currents in the rotor conductors will be in phase with the electro-motive forces induced in them. Whence it results that the maximum currents in them will always occur when the conductors are in that part of the field where the flux density is a maximum. And as the flux is constant at all loads, it follows that the torque will be proportional to the currents in the rotor. But these are proportional to the slip $\Omega - \omega$; hence, also, it follows that Q will be proportional to $\Omega - \omega$, and may be written $Q = b\ (\Omega - \omega)$ where b is a constant depending on the strength of the field, the radius of the rotor, and the length and resistance of the conductors of the rotor.

*From the London *Electrician*.

We may now write:

useful watts $w = b.\ \omega\ (\Omega - \omega)$;

total watts $W = b.\ \Omega\ (\Omega - \omega)$;

wasted watts $W - w = b.\ (\Omega - \omega)^2$.

Hence we may at once apply the now well-known diagram of motor efficiencies, by drawing (Fig. 1) a square $A\ B\ C\ D$, having its side $A\ B$ numerically equal to Ω, and cutting off a piece, $B\ F$, equal to ω. The area $A\ F\ H\ D$ represents the total watts supplied, the area $A\ F\ G\ K$, or $G\ L\ C\ H$, the watts utilized, and the square $K\ G\ H\ D$ the watts wasted in heating the conductors of the rotor. The efficiency will approach unity as F moves up toward A; and the output will be a maximum when $\omega = \frac{1}{2}\ \Omega$, the efficiency being then only 50 per cent.

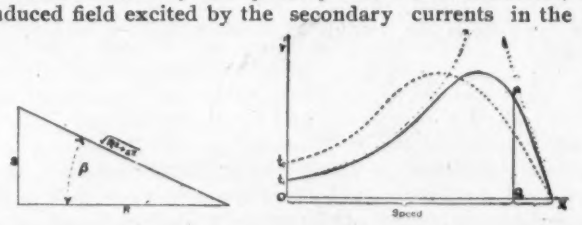
In good modern rotatory field motors, the slip is only, at the most, about 4 per cent., except for very small sizes of machine, where it may be 10 per cent. at full load.

In the above investigation no account has been taken of the loss due to heating in the conductors of the primary or stator circuit. This, like the ordinary $C^2 R$ loss in the exciting circuit of any dynamo, is but a small percentage of the whole energy supplied. Neither has any account been taken of hysteresis losses in the iron of the stator, which also have to be supplied, as it were, by additional excitation, but are small in a well designed machine. Losses by hysteresis, or by eddy-currents in the iron of the rotor, will, like the friction of the journals, deduct from the available power, but these are necessarily very small since the reversals of magnetism in the rotor are proportional, not to Ω but to $\Omega - \omega$.

2. Resultant Magnetic Flux in Motor.

It was pointed out above, from consideration of transformer analogies, that the magnetic flux in the motor is of approximately constant value at all loads. Further, it can be shown to be a consequence from the law of hysteresis, that (in a bi-polar motor) the flux through the rotor core will be of approximately uniform density, and, therefore, that in the gap between rotor and stator it will be distributed with a density which varies as a sine function around the periphery from point to point, though constant at all loads, and rotating with speed Ω. Let the density of this flux in the direction in which it is a maximum be called $\mathfrak{B}$. This flux-density, like the flux-density in a transformer core, is the result of the magnetizing actions of both the primary and the secondary windings. Kapp has given a discussion of the reaction which may be summarized as follows:

Take a line, $\mathfrak{B}$, to represent (Fig. 2) the maximum of the flux-density in the motor; it may be considered as revolving around one end as a centre. This field is due to the joint action of the impressed field excited by the primary currents in the stator, and of the induced field excited by the secondary currents in the rotor.



FIGS. 4 AND 5.

These rotor currents are in phase with the resultant field (if there is no magnetic leakage), proportional to it, and to the slip. They tend to produce a cross-magnetizing reaction. They may be represented by a length, i, set off along the side $\mathfrak{B}$. This current i tends to produce a cross-magnetizing field proportional to itself. Let the line c at right angles to $\mathfrak{B}$ represent this cross field. Here $c = k\ i$ where k is a coefficient depending on construction. Complete the triangle $\mathfrak{B}\ c\ a$ by drawing the line a. Then a represents in magnitude and phase the magnetic field that must be impressed by the primary currents in the stator, since $\mathfrak{B}$ is the resultant of a and c.

Further, since the torque is proportional to both $\mathfrak{B}$ and i — that is to $\mathfrak{B}$ and c— the area of the triangle $a\ \mathfrak{B}\ c$ will represent the torque.

Moreover, since i is proportional to the slip, and to $\mathfrak{B}$, and to a constant depending inversely on the resistance R in the rotor circuit, we may write:

$$i = \frac{\mathfrak{B} \times \text{slip}}{R};$$

$$\text{or slip} = \frac{i\ R}{\mathfrak{B}};$$

and substituting $c \div k$ for i,

$$\text{slip} = \frac{c}{\mathfrak{B}} \times \frac{R}{k};$$

but $c \div \mathfrak{B}$ is tan β, hence slip is proportional to R tan β.

3. Conditions of Operation.

There are three chief stages of operation to be considered; and for the present we will consider the supply voltage constant, and the machine devoid of magnetic leakage.

(*i.*) *Starting.*—Here $\omega = 0$, and slip $= \Omega$. Rotor currents enormous, primary currents also enormous. Therefore, β the angle of phase-difference between primary currents and resultant field very large. Torque enormous if no magnetic leakage.

(*ii.*) *Running at Light Load.*—Here ω is very nearly equal to Ω; and as slip is small, rotor currents will be small, and their reaction small. Angle β will be small, and a will not be much larger than $\mathfrak{B}$.

(*iii.*) *Running with Heavy Load.*—Here $\Omega - \omega$, the slip, must be considerable enough to allow of the generation in the rotor of currents considerable enough to produce the necessary torque at the actual speed of rotation.

In addition to the above, if the speed is artificially brought up to synchronism by supplying from without power to overcome fric tion, etc., there will be no rotor currents and no torque. If the speed is artificially increased beyond this, so that the rotor runs faster than its field, power will be consumed in driving it, and it will act as a generator, pumping back current into the supply network, as pointed out by various writers.

4. Starting Torque if Impressed Field is Limited.

Suppose, now, that for any reason (notably in consequence of even a small amount of self-induction in either stator or rotor, such as would occur if there is any magnetic leakage) the impressed field a is limited in value. This will in fact be the case if even without interior self-induction or leakage the supply is not at constant voltage. Then, when, as at starting, the slip is great, the triangle $a\ \mathfrak{B}\ c$ will become of the form of Fig. 3; for if the slip is proportional to $R \tan \beta$, and R is small, $\tan \beta$ must be very great, or β will be near 90°, and the torque (represented by the area) will be very small. If we increase R we necessarily decrease tan β, making $\mathfrak{B}$ greater and the area greater, and so get a greater starting torque. This is why introducing a non-inductive resistance into the rotor circuit at starting enables the machine to start with a greater torque.

5. Relation Between Torque and Slip.

In order to get an equation for the torque in terms of the slip, and the resistance of the rotor, we note that from Fig. 2 it follows that

$$cos = a \sin \beta,$$

and

$$\mathfrak{B} = a \cos \beta.$$

Now, from the equation $\text{slip} = \frac{c}{\mathfrak{B}} \times \frac{R}{k}$, we get $\frac{\text{slip}}{R} \times k = \frac{c}{\mathfrak{B}}$

Therefore, by merely altering the scale of Fig. 2, we can re-name the sides of the triangle as shown in Fig. 4, where s stands for the slip.

From this we see that

$$\sin \beta = \frac{s}{\sqrt{R^2 + s^2}}, \text{ and } \cos \beta = \frac{R}{\sqrt{R^2 + s^2}}.$$

Therefore, the torque Q, which is proportional to $c \times \mathfrak{B}$, is proportional to $a^2 \sin \beta \cos \beta$; and, therefore, writing q as a constant depending on construction, we have

$$Q = q \cdot \frac{s\,R}{R^2 + s^2}.$$

And here we are also assuming that a, the impressed field, is constant; or that, in other words, the condition of supply is no longer that of constant voltage without magnetic leakage.

If we wish to see graphically what this equation means, we may plot out the relation between Q and s as a curve, assuming a definite value for R.

Take the line $O\ X$ (Fig. 5) to represent the speed of rotation of the magnetic field, and cut off from it a part, $O\ Q$, to represent the speed of the motor. Then the remainder, $Q\ X$, represents the slip. This is equivalent to plotting the slip backwards from X. The vertical ordinates then represent the values of the torque as calculated from the equation. For example, when $Q\ X$ is taken as s; $F\ Q$ is plotted to represent the corresponding value of Q. Thus we get a curve $X\ P\ t_1$, beginning at X when the slip is zero, which rises steeply, comes to a maximum, and dies away to the value $O\ t$, which is the torque at starting. The torque has a certain maximum value for which $\beta = 45°$. It will be noted that the steep end part of the curve is nearly straight, being anasymptote to a straight line, which would represent the relation between torque and slip if the magnetic field is constant and there were no magnetic leakage. In fact, this lines corresponds to the expression $T = b\ (\Omega - \omega)$ in the first paragraph of these notes. Or, if in our present equation we consider values of s which are small compared with R, the equation might be written $Q = q \frac{s}{R}$. At the other end of the curve where slip is great, the curve is hollow. Here we may approximate by supposing that s is very great compared with R, or that R^2 is small compared with s^2; in which case the equation reduces to $Q = q \frac{R}{s}$. This is the equation to a hyperbola (also shown in dot). When the motor is at rest $s = \Omega$, or $O\ Q$ = zero, giving at $O\ t_1$ the value $Q = q \frac{R}{\Omega}$

That is to say, *at starting* the torque is proportional to the resistance of the rotor. If we then assign a higher value to R, and plot out a new set of ordinates, we obtain a new curve (shown in dotted line) which also starts at X, rises to a maximum of the same height as before, and then falls, but this time to t_2. The effect then of introducing more resistance is to raise the torque at starting; but it also has the effect of causing the maximum torque to occur when the slip is greater. The motor gives out practically the same power as before, but runs with a greater difference of speed between its speed at light load and its speed at full load. And the efficiency at full load is diminished. If, with a 5 per cent. slip and a 95 per cent. efficiency, we do not get a sufficient starting torque, we can get it by introducing resistance, and contenting ourselves (at full load) with, say, a 10 per cent. slip, and a 90 per cent. efficiency. And one understands the reason for the modern device of constructing the rotor so that a resistance can be put in at starting, and then short-circuited as soon as the rotor has got up a fair speed.

Electrodynamic Machinery—XIX.

BY EDWIN J. HOUSTON AND A. E. KENNELLY.

97. One of the earliest types of operative dynamos was that in which the field consisted of a permanent magnet, and the armature was of the Siemens, or shuttle-wound, type. This armature consists essentially of a single coil of many turns of wire, wrapped in a deep longitudinal groove, formed on opposite sides of an iron cylinder. Owing to its simplicity, this early type of magneto-electric machine has survived in its competition with more advanced types, for such purposes as signal calls in telephony, and for firing

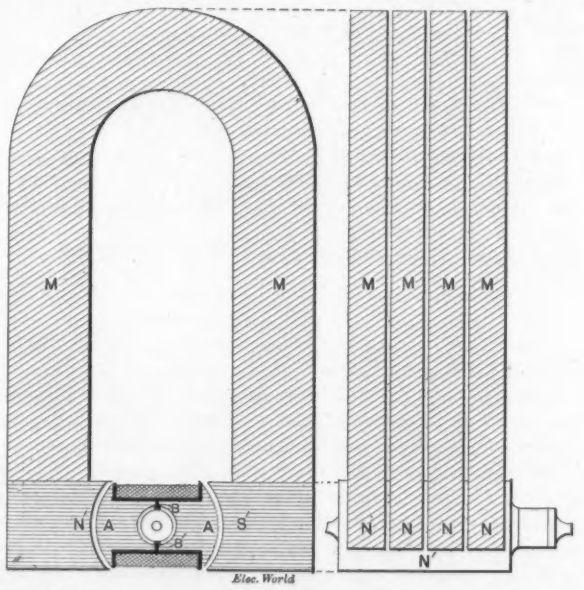
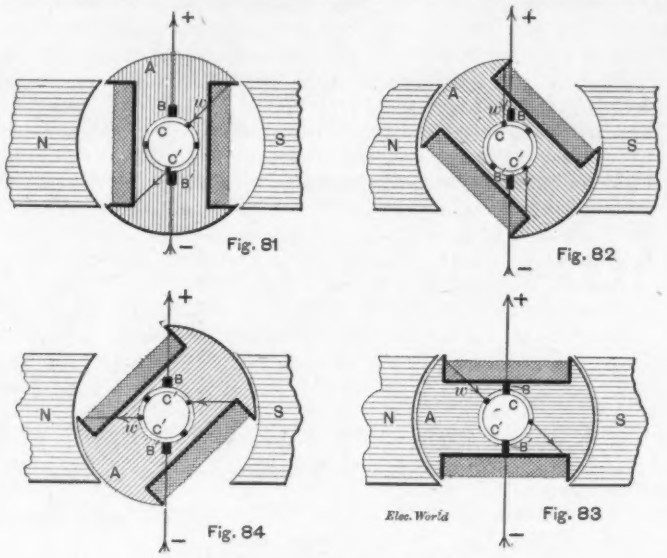


Fig. 80.—Magneto Generator with Shuttle Armature.

electric fuses in mines. A machine of this type is shown in Fig. 80. The magnets $M\ M$, are usually compound; *i. e.*, consist of separate bars of hardened steel with their like poles associated as shown in the side view. The magnets are thus combined to form a single magnetic circuit through the armature, by means of soft iron pole-pieces N′ and S′. The armature core $A\ A'$, was originally formed of a single piece of soft iron, but is now always laminated, that is, formed of sheets of soft iron, laid side by side. The armature winding is in the form of a single coil or spool, and the ends of the coil are brought out to the insulated segments of the two-part commutator $C\ C'$, Figs. 81 to 84.

98. In order to determine the E. M. F. capable of being produced by a generator of this type and of given dimensions, it is

necessary first to ascertain the total quantity of flux which passes through the armature in the different positions it assumes during rotation. As shown in Fig. 81, the armature core lies at right angles to the polar line, and consequently no flux passes directly through its winding. When, during its motion, the armature reaches the position as shown in Fig. 82, where the end *A*, has approached the north pole, the flux is threading through the armature in a direction from the north pole *N*, to the south pole *S*. In Fig. 83, the armature core is shown as lying directly between the pole pieces. In this position the armature gives passage to the maximum amount of flux. In Fig. 84, the armature core is shown as moved beyond this position and is now reducing the



FIGS. 81, 82, 83 AND 84.

amount of flux threading through its core. Continuing rotation until the completion of a half turn, the position shown in Fig. 81, is reached, but now in the reverse direction; *i. e.*, with the end *A*, lowest instead of uppermost; and here the coil is emptied of flux as before.

99. It is evident, from a consideration of the preceding figures, that the amount of flux passing through the armature in any position depends upon the M. M. F. produced by the steel magnets; *i. e.*, upon their dimensions and shape, and on the reluctance of the air-gap, that is, on the dimensions and shape of the pole pieces, as well as on the *entrefer* or *air-gap* lying between the poles and armature.

For practical purposes a steel magnet may be regarded as producing a uniform difference of magnetic potential between its poles, except when the flux passing through the circuit represents an intensity greater than one kilogauss in the steel. We may prac-

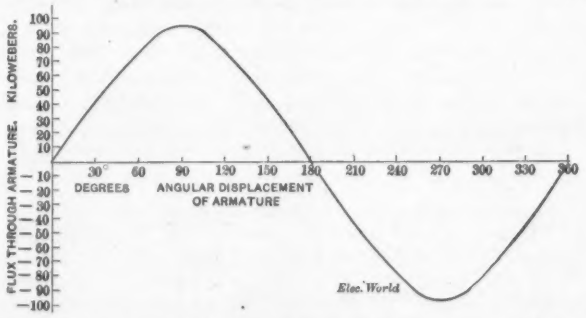


FIG. 85.—DIAGRAM OF FLUX PASSING THROUGH ARMATURE IN DIFFERENT ANGULAR POSITIONS.

tically consider that ordinary hard magnet steel maintains a permanent M. M. F. of 10 gilberts per centimetre of its length, independently of its cross section, and at the same time possesses a reluctivity of $\frac{1}{150}$. If then the magnets shown in Fig. 80, are 30 cms. long and have total cross section of 12 square centimetres, the M. M. F. they produce will be 300 gilberts and their reluctance $\frac{30}{12} \times \frac{1}{150} = \frac{1}{60}$ oersted. Neglecting leakage, the flux which will pass through the armature will, therefore, be $\frac{300}{\frac{1}{60} + \mathfrak{R}}$ webers, where $\mathfrak{R}$, is the reluctance of the two air-gaps in series. If, then, for different angular positions of the armature we plot the total length of air space in cms. (twice the length of the air-gap), and divide by the area of the armature beneath one pole in sq. cms., we obtain the reluctance $\mathfrak{R}$, and, substituting in the above equation, we may determine approximately the magnetic flux through the armature for all positions during rotation.

100. Proceeding in this manner we obtain such a curve as is shown in Fig. 85, which represents the flux passing through the armature core at different position of angular displacement from the initial position shown in Fig. 81, and from actual measurements of a particular shuttle wound machine of this type. An inspection of this figure will show that at 30° displacement the flux through the armature will amount to about 40 kilowebers, while at 90° displacement, the position of maximum flux, it will reach about 93 kilowebers. From this position the flux decreases until at 180° its value is zero, the position assumed by the armature when it has completed one half of a rotation and is again in the position represented in Fig. 81, but in the reverse direction. From this position onward, the direction of flux is reversed, the maximum flux being reached at an angular displacement of 270°, or ¾ of an entire rotation, completing a cycle at 360°.

(To be continued.)

Electrical Power Transmission—V.

BY LOUIS BELL, Ph. D.

Power Transmission by Continuous Currents.

28. The foregoing gives the rudiments of the machines used for generating direct current. It now remains, before taking up the question of power transmission proper, to consider briefly the use of such machines as motors. The underlying principle has been already discussed. The power of a motor to do work depends on the stress of the magnetic field on conductors carrying current in it and free to move. This stress is virtually the same as that which has to be overcome in using the machine as a generator, and reaches a very considerable amount in machines of any size.

In motors with the field strengths often used, the actual drag between field and armature wires may amount as a rough approximation to nearly an ounce pull on each foot of conductor in the field for every ampere flowing through the wire. With a twenty-horse power motor the actual twisting effort or *torque* at the surface of the armature might easily be considerably over a hundred pounds pull. Forces of this magnitude emphasize the need of solid armature construction, with the conductors firmly locked in place, particularly since the magnetic drag is not steady but comes violently upon the conductors as they enter the field. With the old smooth core armatures wound with wire, the conductors not infrequently worked loose and chafed each other, and even the entire winding has been known to slip on the core. In modern windings, either iron clad or modified smooth core, such accidents are nearly impossible.

When the armature conductors of the motor cut through its field as the armature revolves, an electromotive force is necessarily generated in them as in every other case when the magnetic forces on a conductor change. There is thus produced, as a necessary part of the action of every motor, a counter electromotive force in the armature. This electromotive force plays a very important part in the internal economy of the motor and is worth while looking at in detail.

In the first place the magnitude of the counter electromotive force determines the amount of current that can flow through the motor when supplied at a given voltage. The resistance of the armature measured from brush to brush may be only a few thousandths or even ten-thousandths of an ohm, while the applied voltage may be several hundred volts. The current, however, is not that which would flow through the given resistance under the pressure applied, but the flow is determined by the difference between the applied electromotive force and the counter E. M. F. of the motor, so that in starting a motor when the armature is at rest and there is therefore no counter E. M. F., a resistance is inserted outside the armature to cut down the initial rush of current.

In the second place, the counter electromotive force measures accurately the mechanical output of the motor for any given current. It does this because the very same things *i. e.* strength of field, amount of wire under induction and speed, which determine the output for a given current, also determine the magnitude of the counter electro-motive force.

Therefore, when the machine is running as a motor, while the energy supplied to it is the product of the voltage by the amperes which flow through the armature, the output of the motor is de-

termined by the product of the counter electromotive force into the self same current; hence, under given conditions, the ratio between the impressed and counter electro-motive forces of the motor determines the efficiency of the motor. The difference between these electromotive forces determines the input of energy, since it determines the current which may flow; therefore, as the counter electromotive force increases, the efficiency of the motor increases but the output is limited by lessening the input.

With a fixed electromotive force supplied to the armature, the output of the motor per ampere of current will diminish as the counter electromotive force diminishes, but the total amperes flowing will increase because the difference between the applied and counter E. M. F. has also increased. Thus, the total output increases, although at a lower efficiency, when the counter E. M. F. decreases. Since the input (which is determined by the difference between counter and applied E. M. F.'s,) multiplied by the efficiency (which is determined by the counter E. M. F.,) equals the net output of the motor, this output will be at a maximum when the counter E. M. F. and the effective E. M. F. are equal to each other. This follows from the general law, that the product of two quantities, the sum of which is fixed, will be a maximum when these quantities are equal.

29. In actual practice, motors are worked under very diverse conditions and some of these it is worth while to take up in detail following the preceding generalizations. The energy may be supplied at constant current, at constant voltage, with neither current nor voltage constant, at fixed or variable speed and subject to a wide variety of conditions; the motors may be wound either series or shunt, or with various modifications of these windings, and may be either self regulating as regards any of these quantities, or regulated by extraneous means. In the ordinary problems dealt with in power transmission, these conditions may be classified in a fairly simple way as follows:

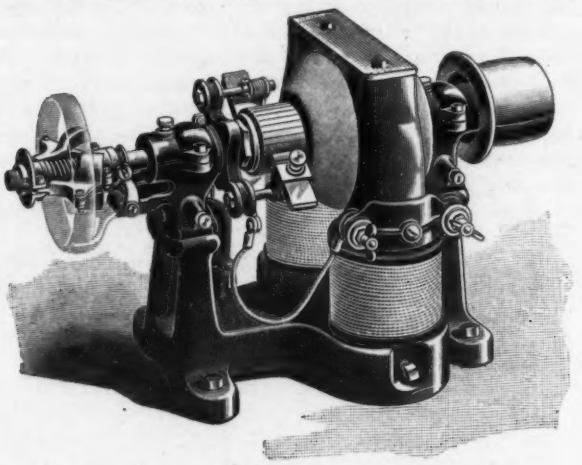


Fig. 18.

Case 1—Series wound motors at constant current.

Case 2—Series wound motors at constant voltage.

Case 3—Series wound motors with interdependent current and voltage.

Case 4—Shunt wound motors at constant voltage.

The first class is now comparatively little used, much less than formerly, and hence is not of great practical importance. The second class is very widely used in a particular case, to wit: electric railway practice, and consequently it is of great importance. The third class of motors is used occasionally with greater success but not very extensively, while the fourth includes the vast majority of all the machines running for purposes other than electric railway service. These cases, therefore, it is worth while to take up somewhat *in extenso*.

30. Case 1—Series wound motors operated with a constant current originally came into use in connection with arc lighting circuits, which for some years formed the most generally available source of current. Such lines are fed from dynamos in which the current is kept constant by special regulation while the voltage rises and falls, in accordance with the load, consisting of lamps or motors in series with each other. We are therefore relieved of any concern about the current, since it is kept constant quite irrespective of what happens in the motor.

Under these circumstances, in series wound motor the torque will be constant, since the field is constant, and the output of the motor will vary directly with the speed. If it be loaded beyond its capacity it simply refuses to start the load, inasmuch as its torque is limited by the current. If it starts with a load within its limit of torque its speed will steadily increase, until that limit is reached. This may be comparatively soon if the load is a rapidly increasing one, or the machine may race until its own friction of air and bearings, magnetic resistances and the induction of idle currents in the core or frame serve to furnish resistance up to its limit of torque. When running at a given speed any increase of load causes the speed to fall off, while decrease of load produces racing. Unless these tendencies are controlled, this type of machine becomes almost useless for practical purposes, as regularity of speed under change of load is generally highly desirable. In fact, the tendency to run at constant torque is generally inconvenient. To obviate this very serious difficulty various devices have been tried with tolerable success. The commonest is to vary the torque in accordance with the load by changing the field strength or by shifting the brushes so as to throw the armature coils out of their normal relation to the magnetic field.

Since the object of such changes is to vary the output at constant current and since this output is measured by the counter E. M. F. of the motor, the real problem of such regulation is to vary the counter E. M. F. in proportion to the output. Therefore the same means that serve to accomplish this end in an arc dynamo, keeping the current constant and varying the E. M. F., will serve to regulate the corresponding motor.

As in this case the speed is the thing to be held constant, the usual means taken for working the regulating devices is a centrifugal governor, which generally acts to shift the brushes or to put in circuit more or less of the field winding, which for this purpose is divided into sections. In still other arrangements the governor acts to slide the armature partially into or out of the field, or to work a rheostat which shunts the field magnet, as in the Brush regulator for constant current. An excellent example of a constant current motor regulated on the last mentioned principle is shown in Fig. 18.

As to the operation of these regulating devices, it is tolerably good if everything is carefully looked after, and kept in adjustment. The efficiency of such motors is not generally as high as that of other types, especially at light loads, owing to the nearly constant loss in the armature due to constant current working.

In addition, the circuit is highly dangerous, coming as it does from generators of very high voltage, and even the voltage across the brushes is, in machines of any size, sufficient to give a dangerous or even fatal shock. A ten-horse power motor, for example, on the customary 10-ampere circuit, would have a difference of potential of about 800 volts between the brushes at full load. As a few such motors would load even the largest arc dynamos, besides being dangerous in themselves, operations have generally been confined to smaller units. On account of the danger and the mechanical and other difficulties, the arc motor has come to be looked upon as a last resort, is seldom or never used when anything else is available, and, to the credit of the various manufacturers be it said, is nearly always sold and installed with a specific explanation of its general character and the precautions that must be taken with it.

In spite of all these objections the constant current motor often does good and steady work, and some such have been used for years without accident or serious trouble of any kind. They have been employed, however, only sparingly for power transmission work of any kind and appear to be steadily passing out of use.

(To be continued).

Practical Notes on Dynamo Calculation—XXI.

BY ALFRED E. WIENER.

40.—Actual Leakage Factor of Machine.

By a very simple method devised by the author [1], the total flux, Φ'' of magnetic circuit of a dynamo can be calculated from the running data of the completed machine, and the actual leakage factor for any particular dynamo can therefore be found for the formula

$$\lambda = \frac{z \times \phi''}{\phi} = \frac{\phi'}{\phi}, \qquad (135)$$

where Φ'' = Total flux of magnetic circuit, in webers, calculated from test-data;

Φ' = Total flux in entire magnet-frame, in webers;

Φ = Useful flux cutting armature conductors, in webers, from formula (91) or (92), respectively;

z = Number of magnetic circuits in machine.

The writer, by employing his method above referred to, has

[1] Electr. Engineer, Vol. XVIII, p. 307 (Oct. 17, 1894).

figured the actual leakage-factors for nearly two hundred practical dynamos[2] of which the complete test-data were at his command, and by combining his results with the researches of Hopkinson[3], Lahmeyer[4], Corsepius[5], Esson[6], Wedding[7], Ives[8], Edser[9], and Puffer[10], has averaged the following Table LII., of leakage factors for dynamos of various types and sizes, which is to be used for obtaining an approximate value of the leakage co-efficient for the preliminary calculation referred to in Chapter 36.

From this table the general rule will be noted that the factor of leakage is the greater the smaller the dynamo, which is due to the difficulty or rather impossibility of properly diminishing the magnetic circuit in small machines. In these, on account of the comparatively large space occupied by the armature-winding, the length of the air-gaps is much larger, and the relative distances of the leakage surface much smaller, in proportion, than in large dynamos; the permeance of the air-gaps, therefore, is relatively much smaller, while the permeances of the leakage-paths are considerably larger, comparatively, than in large machines, and formula (110), in consequence, will produce a high value for the leakage co-efficient for a small dynamo.

It further follows from Table LII. that the leakage factor for various types and sizes of dynamos varies within the wide range of from 1·10 to 2·00, which result agrees with observations of Mavor[11], who, however, seems not to have considered capacities over 100 kilowatts. By comparing the values of λ for any one capacity the relative merits of the various types considered may be deduced.

Thus, it is learned that, as far as magnetic leakage is concerned, the horizontal double magnet type (column 6) and the bipolar iron clad type (column 7) are superior to any of the other types, fact that the magnetic circuit is suspended over an iron surface extending over its entire length, while in the latter type it is due to the comparatively close relative proximity of a great number of magnet-cores (two for each pole) parallel to each other.

(To be continued.)

CAPACITY IN KILO WATTS	FACTOR OF MAGNETIC LEAKAGE, 1 UPRIGHT HORSESHOE TYPE	2 INVERTED HORSESHOE TYPE	3 HORIZONTAL HORSESHOE TYPE	4 SINGLE MAGNET TYPE	5 VERTICAL DOUBLE MAGNET TYPE	6 HORIZONTAL DOUBLE MAGNET TYPE	7 BIPOLAR IRON CLAD TYPE	8 VERTICAL DOUBLE HORSESHOE TYPE	9 HORIZONTAL DOUBLE HORSESHOE TYPE	10 FOURPOLAR IRON CLAD TYPE	11 SINGLE MAGNET MULTIPOLAR TYPE	12 RADIAL MULTIPOLAR TYPE	13 INNER-POLE TYPE	14 TANGENTIAL MULTIPOLAR TYPE	15 AXIAL MULTIPOLAR TYPE	CAPACITY IN KILO WATTS
1	2·00	1·75	.....	1·90	.....	1·50	1·50	.....	.....	.....	.....	.....	.....	.....	.....	·1
·25	1·80	1·60	.....	1·75	2·00	1·40	1·40	.....	.....	.....	.....	.....	.....	.....	.....	·25
·5	1·70	1·50	2·00	1·65	1·90	1·35	1·35	1·80	1·90	.....	.....	.....	.....	.....	.....	·5
1	1·65	1·45	1·90	1·60	1·80	1·30	1·30	1·70	1·75	.....	.....	.....	.....	.....	.....	1
2·5	1·60	1·40	1·80	1.55	1.70	1·28	1·28	1.60	1·65	1·75	1·60	1.50	1·40	1·90	2·00	2.5
5	1·55	1·35	1·75	1·50	1·65	1·25	1·25	1·55	1·60	1·65	1·50	1·40	1·35	1·80	1 99	5
7·5	1 50	1·30	1·70	1·45	1 60	1·22	1·22	1·50	1·55	1·60	1·45	1·35	1·32	1·70	1·80	7.5
10	1·45	1·28	1·65	1·40	1·55	1·20	1·20	1·45	1·50	1·55	1·40	1·32	1·30	1·65	1·70	10
25	1·40	1·25	1·60	1·35	1·50	1·18	1·18	1·40	1·45	1·50	1·35	1 30	1·28	1·60	1·65	25
50	1·35	1·22	1·55	1·32	1·45	1·15	1·15	1 35	1 40	1·45	1·30	1·28	1·25	1·55	1·60	50
100	1·30	1·20	1·50	1·30	1·40	1·12	1.12	1·30	1·35	1·40	1·25	1·25	1·22	1·50	1 55	100
200	1 25	.....	.....	.....	.....	.....	.....	.....	.....	1·33	1·22	1·22	1·20	1·45	1.50	200
300	1 20	.....	.....	.....	.....	.....	.....	.....	.....	1·35	1·20	1·20	1·18	1·40	1·45	300
500	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1 18	1·15	1·35	1·40	500
1000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1·16	1·12	1·30	1·35	1000
2000	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	1·15	1·10	1·25	1·30	2000

TABLE LII.—LEAKAGE FACTORS FOR VARIOUS TYPES AND SIZES OF DYNAMOS.

which undoubtedly is due to the common feature of these types of having the cores of opposite magnetic potential in line with each other on opposite sides of the armature, thus reducing the magnetic leakage between them to a minimum.

Next in line, considering bipolar dynamos, are the inverted horseshoe type (column 2), the single magnet type (column 4), the upright horseshoe type (column 1,) and the vertical double horseshoe type (column 8).

Of multipolar machines the two best forms, magnetically, are, respectively, the inner-polar type (column 13) and the radial multipolar type (column 12.) In the first named of these types the magnetic-cores form a star, having a common yoke in the center, and the polar-pieces at the periphry; thus the distances of the leakage paths increase in direct proportion to the difference of magnetic potential, a feature which is most desirable and which accounts for the low values of λ for the type in question.

The most leaky of all types seem to be the horizontal single horseshoe type (column 3) and the axial multipolar type (column 15). In the former type the excessive leakage is due to the

[2]For list of machines see Introduction, Electr. World, Vol. XXIII, p. 675 (May 19 1894).
[3]J. & E. Hopkinson Phil. Trans, 1886. Vol. I.
[4]Wm. Lahmeyer, Elektrotechn, Zeitschr., Vol. IX. p. 89 & 283 (1888).
[5]Corsepius, Elektrotechn. Zeitschrift, Vol. IX.p. 235 (1888).
[6]W. B. Esson, The Electrician, (London), Vol. XXIV, p. 424 (1890); Journal Inst. Elec. Eng., Vol. XIX, p 122 (1890).
[7]W. Wedding, Elektrotchn, Zeitschr. Vol. XIII, p. 67 (1892).
[8]Arthur Stanley Ives, Electr. World, Vol. XIX. p. 11 (Jan. 2, 1892).
[9]Edwin Edser and Herbert Stansfield, Electr. World, Vol. XX, p. 180 (Sept. 17, 1892).
[10]Puffer, Electr. Review (London), Vol. XXX, p. 487 (1892).
[11]Mavor, Electr. Engineer (London), April 13, 1894; Electr. World, Vol. XXIII, p. 615 (May 5, 1894).

Over Compounded Dynamos in Parallel.

BY A. F. HEMINGWAY.

I noticed in a recent issue of The Electrical World an article on the working of compound wound dynamos in parallel by Prof. E. P. Roberts, in which one trouble put forward was the lack of proper regulation when not all of the dynamos are in circuit.

It is evident that if a pair of such dynamos of equal capacities are working in parallel and over-compounded 10 per cent. with 10 per cent. loss in the feeders, and the load drops to a point (say one-half) where one dynamo is sufficient to handle it, the P.D. at the terminals with the single dynamo remains 10 per cent., while the loss in the feeders is decreased to 5 per cent.; there thus results an increase of voltage of 5 per cent. at the lamps, thereby decreasing their life efficiency.

The writer has in mind a method that may be added to those given by the author of the article mentioned, taking the case as cited above and shown in the accompanying sketch. The method consists in cutting out the required number of turns in the series coil, in this case about one-half, which results in only five per cent. rise in volt age in place of ten, and this without any additional manipulation of switches when the change is being made. Referring to the sketch A, B, C, A_1, B_1, C_1, are the main switches, and D, D_1, jaws with the terminals of the short series coil and main connected. Assuming that the dynamos are running and giving their proper current and the load drops where it may be thrown upon one dynamo, by opening the switches A. B. C., the blade marked C engages with the jaws D, which closes the circuit containing the short series coil

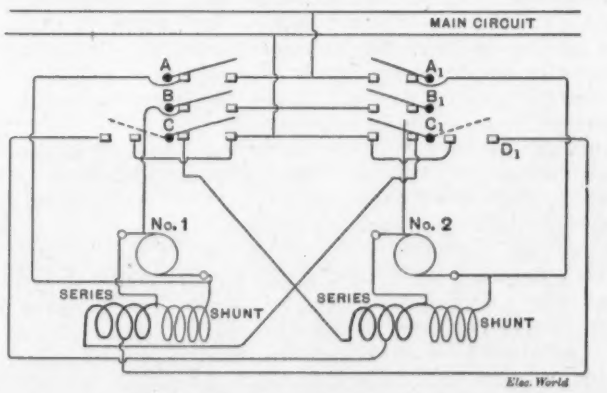


DIAGRAM OF CIRCUITS.

of the dynamo in operation, thus giving the required potential at its terminals. It will be seen that the arrangement will in no way affect the regulation when both are running in the usual way and that two or more dynamos of equal or unequal capacity may be arranged to give the same results,

The Chloride Accumulator.

The Electric Storage Battery Company announces officially that it has acquired all the patents and patent rights concerning the manufacture of electric storage batteries of the General Electric Company, the Edison Electric Light Company, the Thomson-Houston Electric Company, the Brush Electric Company, the Accumulator Company, the Consolidated Electric Storage Company and the General Electric Launch Company, whereby the Electric Storage Battery Company has secured to itself the sole right to supply in the United States electric storage batteries of all the various important types heretofore developed, as well as the protection of every decision heretofore rendered by the United States courts in the interpretation of electric storage battery patents. The acquisition of these patents, the company states, not only terminates all litigation heretofore existing, but insures against any future attacks, as the patents acquired together with those originally owned by the Electric Storage Battery Company cover all the known principles involved in storage batteries. It announces that it has also increased largely its cash working capital, and is now fully prepared to fill all orders for storage batteries.

The Foundations of Mathematical Analysis.

To the Editor of The Electrical World:

Sir:—In a recent article on Electromagnetic Theory (London *Electrician* Nov. 23) which formed the occasion of the editorial reproduced in your columns (The Electrical World, Dec. 8.) Mr. Heaviside favors us with his view of the foundation of mathematics. He says that mathematics is fundamentally an experimental science; and that the science of nature might be studied as a whole, the properties of space along with the properties of the matter found moving about therein; and that it would be to the advantage of a student of physics to pick up his mathematics along with his physics. From this and other statements in the article I gather that in his view the properties of space constitute the foundation of mathematics, while the properties of matter constitute the foundation of physics. He shows explicitly how geometry has an experimental, (or rather experiential) foundation; but to make good the general statement it is necessary to show that algebra also has an experiential foundation.

At the present time it is customary for writers on algebra to place that science on a purely formal basis. The rules which are to be followed in the manipulation of symbols are enunciated as formal laws—called the laws of commutation, association, and distribution—and very little attention is given to the meaning of these laws as truths of nature. They were found to be true of integer numbers, and they are supposed to be true for any extended meaning of the symbols. The consequence is that the development of algebra is arrested at angles in a plane, the further step to angles in space is not being taken because these supposed necessary laws cease to apply. The extent to which these fundamental laws are true in space analysis, and the points where they break down or require to be modified, were shown at length in a paper which I read before the American Mathematical Society at their Brooklyn meeting. From that and other investigations I am led to the view that the properties of space are the foundation of pure mathematical analysis, while those of space, time and mass constitute the foundation of what is called applied mathematics. These two parts of analysis merge into one another; they are equally pure, equally exact, and they equally apply to that of which they are the analysis. The difference lies not in purity, exactness or applicability, but in the fundamental ideas or subject of analysis.

Mathematicians who maintain the formal view of algebra encounter a difficulty in the obviously geometrical nature of the cosine, sine and other circular functions. The hyperbolic functions also have a geometrical meaning; while the exponential function has an intimate relation with both. But remove the circular, the hyperbolic and the exponential functions from the higher analysis, and how much will then remain? The formal view has led some analyists to the extreme step of defining the sine and cosine as the sums of certain infinite series. But in reply, it may be pointed out that the equality of the sine to the sum of a certain series is not a definition, but a truth, and a very striking truth to anyone who makes the calculation for a large angle.

I am convinced that progress in mathematical analysis will be accelerated by taking an intensely geometrical, even a physical, view of the foundations.

Ithaca, N. Y. Alexander MacFarlane.

The National School of Electricity.

To the Editor of The Electrical World:

Sir:—Permit me to commend your very judicious editorial in The Electrical World of Deceember 8, on the National School of Electricity. It is very evident that a widespread desire exists to learn more about electricity. In fact it was this demand that led to the organization of the National School. It has been very successful in forming classes; and though a mistake has occasionally been made in obtaining local instructors, yet the majority of them by far have been capable young men.

Those whom I have recommended for classes in this vicinity have been appointed, and I know them to be capable and honorable.

But the time has now come for the organization to take the public more into its confidence. The "Honorary Faculty" were expected to aid the movement by honorable means only and to prepare the lessons; in some cases also to deliver addresses or lectures before such classes as they could reach without too much inconvenience. The lessons have been prepared thus far by one member of the "Honorary Faculty" who very properly receives a reasonable compensation for his services. I have myself read the proof I think of all the lessons and have made some suggestions, and, it may be proper to add, without compensation. Another member, who is best fitted for the work, will have charge of the preparation of another course of lessons in a special line. The lessons are thus actually prepared by members of the "Honorary Faculty." To the management the school is doubtless a business venture, with the expectation and evident desire to give to the young men who enter the classes full value for their money. But while the plan is an honorable one, its inception is beset with difficulties and it is certainly capable of improvement. The changes which are required to insure success, I understand, are about to be made.

Ann Arbor, Mich. Henry S. Carhart.

Efficiency of Street Railway Generating Plants.

To the Editor of The Electrical World:

Sir:—In your issue of Dec. 1st appears an editorial criticism of the article by Mr. G. H. Davis on "Economy Tests of Electrical Railway Plants" printed in the same issue, and I quite agree with you as to the reported efficiencies being unattainable in ordinary railway work. As far as station efficiency alone is concerned, there seems to me one way every station manager can keep a fairly accurate eye on results, daily or weekly, and that is by having recording watt-meters to register the output. From this the actual amount of coal per horse-power hour is readily determined. If there are any stations approximating the result given by Mr. Davis, day in and day out, I am quite sure all station managers would be glad to learn how the results are attained, and in any event all station managers would be glad to know just what others are doing.

Reports embodying *exact measured results* in actual running, month in and month out, and including the cost of coal per ton of 2,000 pounds, the kind of coal used, and the horse-power per hour or day, would be of the greatest of value. In talking with a large number of managers in the last few months I have been struck with the fact of how few really know what their output is, beyond the maximum or minimum readings and a guess at the average.

A. C. Balch.

Portland, Ore.

Transformer Testing.

In the article on "Transformer Testing," in our issue of December 8, line twenty-nine, on page 593, should read, "when secondary circuit is open" instead of "when secondary current is open;" also, beginning line forty-two, next column, read, "The core loss, which is constant at all loads, may be got by multiplying the apparent power absorbed at no load by 0.8," instead of by "OS" as printed.

State Telegraphy Silver Wedding.

A proposal is under consideration in England to celebrate in some becoming way the Silver Wedding of the State and the Electric Telegraph. That union was effected on Feburary 5, 1870, and the parties will, therefore, have reached the twenty-fifth year of a prosperous and profitable wedded life on February 5th next year.

DIGEST OF CURRENT TECHNICAL ELECTRICAL LITERATURE

COMPILED FROM PRINCIPAL FOREIGN ELECTRICAL JOURNALS

BY CARL HERING

ELECTRO-PHYSICS.

Vaporization of Carbon.—An academy paper, by Mr. Moissan, is published in "L'Elec.," Nov. 24, and abstracted in "L'Eclairage Elec.," Nov. 17. He describes some new researches with his electric furnace; the current used was about 1,000 to 1,200 amperes and 80 to 90 volts; a rod of pure carbon was vaporized, and formed a sort of felting in depositing; heated in a vacuum it was transformed in ten minutes into graphite; his object was to find whether carbon passed through a liquid state before being vaporized, and from his results he concludes definitely that carbon, if pure, did not liquify; with impure carbon, however, the results were different. He obtained similar results with carbon for sugar and with charcoal; when gaseous carbon solidifies it always changes into graphite; this is also shown in an incandescent lamp, in which, he says, the deposit on the globe will be found to be graphite. He believes, however, that carbon can be made to liquify, but only under pressure; and in that case, as he has shown, the density of the carbon increases, forming diamonds. In solidifying under these circumstances it may form as crystals, as globules, or in an amorphous state.

Cathode Rays.—A paper by Mr. Brooks is begun in the Lond. "Elec. Rev.," Nov. 30. He discusses the views recently published in that journal (see Digest Nov. 24), in which it was stated that the results recently obtained by Dr. Leonard were not in accordance with Crooke's theory or with the kinetic theory of gases. He does not believe that these views will be generally accepted, and he examines the facts upon which these conclusions are based.

Nature of Cathode Rays.—"L'Eclairage Elec.," Nov. 17, contains an article by Mr. Blondin in which he gives a resume and a discussion of the subject, concluding that the hypothesis of Lenard, is a very probable one, but as the nature of these rays is still uncertain, one should wait for further experimental results before accepting this hypothesis.

Reflection and Resonance.—An article by Mr. Birkeland, from the "Weid. Ann.," Vol. 52, page 486, is abstracted in "L'Eclairage Elec.," Nov. 17.

The Work of Hertz and the Results.—An article by Prof. H. Ebert on this subject is contained in the "Rev. Gen. des Sciences," Oct. 30.

Origin of Frictional Electricity.—A paper by Mr. Christiansen from the "Weid. Ann.," Vol. 53, page 401, is abstracted in the "Elec. Zeit.," Nov. 29. He describes experiments which he claims prove that friction by itself produces no electricity, but that the action which is usually attributed to friction arises from chemical decomposition, produced by the contact and the subsequent separation.

Energy of the Amperian Molecule.—In the "Phil. Mag." for December, Mr. Chattock publishes a note supplemental to his paper, abstracted in the Digest Nov. 24.

Conductivity and Pressure.—A paper by Mr. Tammann, from the "Zeit. fuer. Phys Chem.," Vol. 14, page 433, on the alteration of conductivity in liquids by pressure is recommended and briefly abstracted in the Lond. "Elec. Rev.," Nov. 30. It is of a theoretical nature, and it is believed that the line of investigation may turn out to be very fruitful.

Electricity.—The seventh paper by Mr. Walker, on "What Is Electricity?" is published in the Lond. "Elec. Eng.," Nov. 30. He discusses the reflection of electrical waves. He believes that the nature of electricity is simply a mode of motion just as heat, light and sound, but at a different rate, and possibly in a different manner. He showed if it could be shown that electrical waves are reflected and refracted it would be a strong argument in his favor. Hertz went a long way toward proving this.

Demonstrating the Existence of Thermo-Electric Currents.—A lecture apparatus exhibited at the French Physical Society by Mr. Guillaume is described briefly in "L'Ind. Elec.," Nov. 25. A wheel about 6 inches in diameter has its felloe made of a fine wire of an alloy of nickel and copper, and its spokes of fine copper wires, the wheel turning on pivots; a horse-shoe magnet placed so as to "embrace a semi-diameter of the wheel. If the other extremity of this diameter is heated the wheel will revolve.

Thermo-Elements of Metals and Solutions.—A paper, by Mr. Hagenbach, from the "Weid. Ann.," Vol. 53, page 447, is abstracted in the "Elec. Zeit.," Nov. 29.

MAGNETISM.

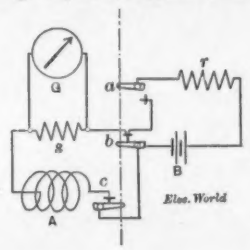
Critical Point in Nickel.—A paper, by Mr. Heydweiller, from the "Weid. Ann.," No. 7, p. 462, is abstracted with curves and tables in the Lond. "Elec.," Nov. 30. Villari observed that with iron under tension the increase in permeability reached a maximum, then fell to its original value and then below this. The point at which it attains the same value that it had with no tension, is known as Villari's critical point. Up to now no such point has been observed in nickel. The present experiments were undertaken with the intention of settling the point, whether the difference between iron and nickel was qualitative and not merely due to the fact that the values used heretofore were not sufficiently low.

Mirrors of Magnetism.—A Physical Society paper, by Prof. S. P. Thompson and Mr. Walker, describing some experiments, is briefly abstracted in the English journals of Nov. 30.

Intense Magnetic Fields.—A good illustration, with all the accessories, of the intense magnet of du Bois, mentioned a number of times in these columns, is published in "La Nature," Nov. 24.

UNITS, MEASUREMENTS AND INSTRUMENTS.

A Simple Method for Determining Inductance-Coefficients.—In the "Elec. Zeit.," Nov. 29, Dr. Hiecke describes a method which he published in June, 1887, in the reports of the Vienna Academy. It requires no condensers, nor any compensation in a bridge method the former of which is generally a source of inaccuracy. The arrangement is shown in the accompanying diagram, in which A is the coil to be measured;



METHOD OF DETERMINING INDUCTANCE COEFFICIENTS.

G, s is a galvanometer with its shunt; r is an inductionless resistance, and a, b, c, are three switches which are operated by a weight which descends with its own acceleration along a vertically stretched wire, falling about 1.5 meters before striking the switch a. The exact time of closing the first switch is not so very important, but that between striking the 2d and 3d switches can be determined very accurately. The 2d contact b, can be adjusted with a micrometer screw. A second test is made with an inductionless resistance R in place of A. The resistance of the cells, if small, need not be considered, or can be included with r. The inductance coefficient and the resistance of the galvanometer do not enter into the final formula if

$$\frac{s^2}{(G+s)\,(R+r+s)}$$

and the corresponding expression for R^1 in place of R are negligibly small in comparison with unity (R being the resistance of the coil A). This can easily be reached with the Thomson mirror-galvonameter. Owing to the fact that the resistance of the switch a was relatively great, a small current circulated when it was closed. Let the deflection due to both this and the succeeding current together be ϕ, then replace A with R' and let the deflection be ϕ. To correct these for the first current impulse it was determined separately by lowering the switch b so that c was opened before b. Let the deflections for A and R be ϕ and ϕ' both of which are always very small; then an approximate value of the self-inductance coefficient will be given by the formula

$$S^1 = t\,r_1\,(1 - \frac{\phi - \psi}{\phi^1 - \psi^1}\,\frac{r_1}{r_1{}^1}$$

in which $r_1 = R + r + S$ and $r_1{}^1 = R^1 + r + S$; t is the time (presumably in seconds) between the opening of switches b and c. This is under the assumption that the time t is sufficiently great to cover the period during which the induction phenomenon acts. If not quite sufficient the difference between this and the true value is very slight, and can be calculated from the following formula (it is not stated whether the result is in henries or absolute units).

$$S = S^1\left(1 + e^{-\frac{r_1}{S^1}t}\right)$$

An example is worked out. He gives three methods by which the time t may be determined.

Telephonic Measurements of E. M. F.—In a paper on this subject, by Mr. Barus, of Washington, D. C., published in the "Phil. Mag." for December, he discusses the use of the telephone in place of the galvanometer in zero methods. He found great difficulty in making the telephone sensitive enough, and shows that the range on both sides of zero within which the telephone does respond, is out of proportion with the sensi-

tiveness of the instrument. The object of the present paper is to find the extent and character of this silent interval, and its relation to the method in question. He quotes the literature on the subject, and describes the apparatus and the method which he used, including a table of results. He concludes that in the measurement of the E. M. F. the telephone does not come up to the requirements. It is possible to define an E. M. F. of about one volt with an accuracy of about one in 1,000. For pyrometry the telephone can be used only in rough work.

Determining Conductivities.—The Lond. "Elec. Rev.," Nov. 30, calls attention to a paper by Mr. Wildermann from the "Zeit. fuer Phys. Chem.," Vol. 14, page 247, in which he describes a new method which has important advantages over the Kohlrausch method, which appears to be unsuitable for slightly dissociated compounds, and almost useless for organic bases or acids in alcohol or other organic solutions. The chief difference lies in the use of a far stronger E. M. F., by which the polarization becomes practically negligible, and a galvanometer can be used instead of a telephone. The measurement of conductivity resolves itself into the measurement of the current. He uses about 150 volts, and places the liquids in capillary tubes. The method is said to have considerable value.

Localization of Faults in High Tension Net Works.—In the Lond. "Elec.," Nov. 30, Mr. Raphael gives a summary, with illustrations, of the methods which may be used first while running, and second when disconnected. The methods themselves do not appear to be new, although some of the details may be useful. The method of testing from the station with the aid of pressure wires appears to be the well-known bridge method in which the wire is connected to the two station ends of the two feeders between the other ends of which the fault lies. Another method described is the ordinary fall of potential method. Regarding the telephone method in which the operator walks along the street with a triangular shaped coil held parallel to the cable, he states that it cannot be relied upon to locate the fault and is often misleading.

Measuring the Capacity of a Condenser.—A physical Society paper, by Mr. Womack, on a modification of the ballistic galvanometer method of determining the electromagnetic capacity of a condenser is briefly described in the English journals of Nov. 30.

Electrometer.—A new form designed by Prof. Ayrton and Mr. Mather, is described in a Physical Society paper abstracted in the English journals of Nov. 30. The fixed and moving parts (inductors and needle) are alike cylindrical in form (the term being understood in its most unrestricted sense) and the generating lines are vertical. There is a vertical axis of symmetry, such that the disposition of these cylindrical parts would remain unchanged if the instrument were rotated thorugh 180 degrees about the axis. The needle is hung by a very thin phosphor-bronze strip, and to obtain a reading when it differs in potential from the inductors by an amount which has to be measured, it is brought back to its ordinary zero position by turning a torsion head to which the upper end of the suspending strip is fixed. The potential difference is then proportional to the square root of the angle through which the torsion-head has been turned; but the E. M. F. of a moderate battery of accumulators can be read with very fair accuracy The authors have bestowed great care on the design of the needle, so that for a given potential difference the turning moment divided by the moment of inertia may be as great as possible. The whole instrument is protected from external inductive influence by having the inner surface of its glass case coated with a transparent conducting varnish, which Prof. Ayrton has described elsewhere. He also showed an idiostatic electrometer, in which the needle was pivoted on an axle. The instrument is nearly dead-beat, and gives about three inches for 100 volts.

Sensitive Form of Thomson Galvanometer.—In the "Phil. Mag." for December, Mr. Wadsworth, of Washington, D. C., describes a sensitive form devised by himself, the description being accompanied by good illustrations. The description does not admit of being abstracted, and those specially interested should read the original. The coils have a peculiar shape, the object of which is to obtain the most economical disposition of the wire with, apparently, as low a resistance as possible. The total number of turns is almost 10,000, and the resistance is 86 ohms. The constant, with a magnet system, which he says could be improved considerably, was 4×10^{-11}, inches, which represents the current in amperes required to produce a deflection of 1mm. at a distance of one meter, for a time of single swing of 10 seconds. He discusses at some length the question of the influence of the mass of the magnetic system on the delicacy.

Amyl-Acetate Lamp.—According to a report of the German Reichsanstalt, the moisture in the atmosphere effects the candle-power of the Hefner lamp to the extent of several per cent. This is important only for very accurate measurements, and need not be considered in ordinary measurements in which the accuracy of the measurements depends more on the ampere and voltmeters, as the candle-power of incandescent lamps varies "eight times as rapidly as the energy."

Specific Inductive Capacities of Water, Alcohol, Etc.—In a short article by Mr. Fessenden, in the "Phil. Mag." for December, he points out that the values obtained by various experiments are not correct, but that the true values in all of these substances are very nearly equal, and what is called for by Maxwell's theory, that is, to the square of the refractive index. The reason for the errors lies in the fact that electrolysis gives a capacity effect. Kohlrausch's method always gives erroneous results, as it measures the impedance and not the resistance. All capacity measurements made by a discharge are also incorrect. The only correct method consists in purifying the fluid until it no longer conducts appreciably, and also by using a powerful source of current. He states that all the determinations for sulphur, etc., are also incorrect.

Physical Units.—The serial by Mr. MacLean is continued in the Lond. "Elec. Eng.," Nov. 30. He discusses the electro magnetic system.

ARC AND INCANDESCENT LIGHTS.

Continuous and Alternating Current Arcs.—The discussion of Dr. Fleming's paper (see Digest, Nov. 17 and Dec. 8), is concluded in Lond. "Lightning," Nov. 29. Mr. Ferranti stated that although he had done his best in favor of alternating current arc lighting, he now admits the superiority of the continuous current lamps, quite apart from the question of efficiency. The alternating arc gives an unpleasant violet light, which he thinks is a most objectionable feature. He mentioned that Dr. Fleming's comparison had nothing to do with the mechanism of the lamp, and he believes that no improvement can better the state of affairs which was found. The vital point of difference in efficiency lies in the fact that in one case, almost the whole energy is used to incandesce one crater, whereas in the other the same amount of energy must be distributed over two surfaces, and consequently the economy of the one can never reach that of the other. The difference between the true watts and the apparent watts is only about 5 per cent. In order to produce the same mean spherical candle-power in the alternating current arc, it is necessary to expend about 50 per cent. more power. But this assumes a perfect reflector near the arc, which is an impossible assumption, and therefore to get about as good a practical effect, nearly twice the energy will be required. Mr. Kolle reduced the diagrams to the same scale, which is published, and shows that it then clearly points out the advantages of a direct current lamp for street lighting. Alternating arcs have their special sphere in the lighting of low interiors. He favors the use of rectifiers. Dr. Fleming, in closing the discussion, replied principally to the remarks of Mr. Preece, which he thinks show that his paper was not read with sufficient care, and in which he claims to have been misquoted. He refers to the recent researches of Messrs. Roessler & Wedding (see Digest, July 7, Aug. 4, Sept. 22), who came to the same conclusion after an elaborate series of experiments. He claims that to use one and the same form of lamp in his tests was the only proper thing to do. He is at present repeating the tests. He admits, that aside from the question of the relative energy consumption there remains the question of practical convenience, to which great weight must be given. Regarding the point brought out by Mr. Wright, namely, that with an equal amount of energy, both should give an equal amount of light. He explains that the usefulness of any radiation for the purpose of vision depends on the wave lengths of that radiation. An arc which converts energy mostly into red, yellow and green rays is the most efficient for purposes of vision.

Aluminium Leading in Wires.—A system devised by Mr. Bolton is described and illustrated in the Lond. "Elec.," Nov. 30. The two wires are fused in a rod of glass which cracks when it cools owing to the difference of expansion; the glass is then fused into the end of the lamp and the joint between the glass and the wire made tight by applying a drop of a strong solution of mercuric chloride, to the outer ends of the wires during the exhaustion of the lamp; this substance oxidizes the aluminium, which oxide is said to make an air-tight joint; should a small leak occur it will cure itself by the action of the oxygen on the remaining aluminium amalgam, precisely at the point where it is needed.

Holophane Globes.—Some good illustrations of the holophane globes described in the Digest, Nov. 10, are published in "La Nature," Nov. 24.

Interior Illumination.—An abstract in French of the article by Mr. Nerz (see Digest, Sept. 22) is published in "L'Eclairage Elec.," Nov. 17.

ELECTRIC RAILWAYS.

Traction.—The article by Mr. Pellissier, mentioned in the Digest, Dec. 8, is concluded in "L' Ind. Elec.," Nov. 25. He discusses the total force of traction, the practicable application of the tables which he gives and the subject of adherence.

Propulsion of Boats.—The system described in the Digest, Nov. 3 and 17, is the subject of an illustrated article by Mr. Guilbert in "L'Eclairage Elec.," Nov. 17; the illustration includes good working drawings, to scale. The results and tests were very satisfactory; with the velocity obtained, 2.4 miles per hour, and the time gained in passing locks, it is easy with the new method to double the total velocity and to obtain a mean speed of 18 to 21 miles per day.

Electric Carriages.—An article by Mr. Reyval is begun in "L'Eclairage Elec.," Nov. 17. He believes that carriages run with petroleum or steam are too expensive and that the ideal power is electrical energy. He gives a summary of the history of electrically operated carriages.

CENTRAL STATIONS, PLANTS, SYSTEMS AND APPLIANCES.

Small Gas-Engine Accumulator Stations.—The "Elek. Anz.," Nov. 29, gives the details of an estimate apparently made by a German firm, of the cost of a small station; the figures are approximately as follows in dollars: Building, $2,420; engine and dynamo for 115 volts and about

165 amperes, complete, $7,500; accumulators, 62 cells of 572 ampere-hours, $4,000; total, including switchboard accessories, crane and tools, $15,000; for the running cost it is assumed that there will be 750 lamps and that they will be used on an average 900 hours per year; also that 40 per cent. of the total energy is supplied by the accumulators, on which account 15 per cent. is added to the gas consumption; this gives a total gas consumption per year of 1,500,000 cu. ft.; for oil he allows $123 per year, for waste $75, for the maintenance of the accumulators 5 per cent. of their cost, sulphuric acid $50, for attendance $750 for two men, and $125 for general office expenses; at two different prices for gas he finds that the interest earned on the capital will be 17.1 per cent. or 12.9 per cent.

Day-load.—An editorial in the "Elec. Zeit.," Nov. 29, summarizes briefly the methods used in three English central stations for reducing the relative cost of the output during the day; at Bristol the current during the day is generated by a gas-engine running about eight hours in winter and relatively longer in summer, thus reducing the attendance during that time to about one-third; in Worcester the dynamos are run during the day by water power alone, which, though not sufficient for the night-load, is ample for the day-load; at Ealing, the town refuse is used as part of the fuel and during the day the refuse alone is sufficient.

Electrical Industry in France.—Some of the comparative data from a recent paper from the "L'Ind. Elec." (see Digest, Nov. 17), giving some figures concerning a few of the largest stations in Europe, are published in the Lond. "Elec. Rev.," Nov. 30.

Installations in Switzerland.—Some interesting statistics for the year 1893 are given in "L'Ind. Elec.," Nov. 25; the increase in the number of installations in 1893 was about 21 per cent.; at the end of the year about 52 per cent. of the generators were driven by hydraulic power.

Altona.—A large amount of data concerning the operation of this station for one year, is published in the "Elec. Zeit.," Nov. 29.

Bedford.—A long and well-illustrated description of this station is published in the Lond. "Elec. Eng.," Nov. 30; the high pressure alternating system is used with sub-stations and the three-wire method.

Elastic Couplings for Gas Engines.—A theoretical discussion by Mr. Guillaume is published in 'L'Ind. Elec.," Nov. 25.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Cable Signalling.—Some recent experiments with data regarding the speed, are given by Mr. Delany in the Lond. "Elec.," Nov. 30. They were made on several of the Atlantic cables with a specially designed system of automatic transmission; a mean of 274 messages on a certain day showed a speed of 88 letters per minute, and on another occasion 95.5 letters per minute; on another occasion 111 letters per minute were transmitted and repeated back without any error. An experiment was made with a repeating system arranged by him, which, from the results obtained, he believes will lead to important changes in cable working; he claims that they show beyond any doubt that transmissions may be effected from long land lines into ocean cables at the same speed as cables are worked. He also mentions a system with which he has been working, for using the key and sounder for long cables; recently with the 1894 cable he transmitted 66 letters per minute with an ordinary Morse sounder, which were automatically repeated to London and were pronounced good signals; with a special transmitter he thinks that a speed of 100 letters per minute could have been reached; he believes that in the near future all long cables will be operated by the automatic machine system. In an editorial discussion, belief is expressed that the annual cost of long land line is by no means insignificant and that it certainly would be cheaper for a company owning more than one cable, to work a single land line with a high-speed Wheatstone rather than to provide a land line for each cable; the editorial concurs in the opinion that long cables will be worked by the automatic system.

Pacific Cable.—The "Jour. Telegraphique," Nov. 25, publishes a very good map of the Pacific ocean with the five different proposed cables starting at Victoria, and discusses them; it prophesies that the realization of this crowning work is but a few months distant; the article considers the accusations of Siemens of great value, but those of Sandford Fleming as a little optimistic and leaving some doubts. In conclusion it states that a Pacific cable from New Caledonia through the Sandwich Islands should connect with the nearest shore of the United States, as, for instance, at San Diego in California, this being unquestionably the shortest and cheapest route; the dangers of such a cable against the security of the British possessions it believes are purely imaginary; such a project "should have a cosmopolitan character and it should fulfill in the most effective manner one of the most noble ends of telegraphy, that is, to tighten the bonds of the great human fraternity."

Berlin-Vienna Telephone Line.—According to the English journals of Nov. 30, this line, which is about 500 miles long, has just been completed and the first tests were very successful; it is believed that it will soon result in a second and even a third line being constructed.

Time Distribution in the United States.—An illustrated descriptive article by Mr. Pellissier is begun in "L'Eclairage Elec.," Nov. 17.

Fire in a Telegraph Building.—The article mentioned in the Digest, Dec. 8, is abstracted with illustrations in the Lond. "Elec.," Nov. 30.

ELECTRO-CHEMISTRY.

Lead-Dust Accumulator.—"Ind. & Iron," Nov. 30, gives an illustrated decription of this accumulator as it is being introduced in England. It is claimed that other attempts to use finely pulverized lead have been unsuccessful because the change into peroxide involves expansion, which destroys the plate by buckling; the process used is to mix the lead-dust with pumice stone powder in the desired proportion, then moisten this with water, producing a plastic material which is then placed into the grids; this has to be done quickly as the paste has a tendency to set; it is claimed that the inert pumice stone enables the active material to expand without destroying the plate; the time for forming is said to be only one-fifth of that required for the ordinary pasted plates, and the capacity is said to be from 3.32 to 5.2 ampere-hours per pound of electrodes, according to the rate of discharge; the rate of discharge given in the table corresponds to four hours for a minimum and ten hours for a maximum time of discharge, and in this respect it therefore does not differ from the other accumulators; these figures appear to be given by the maker; the accumulators have been used for train lighting in Germany since 1891.

Lead Cells.—Mr. Pery in "L'Elec.," Nov. 24, gives the results of some tests made with a spongy lead plate as the negative, and with a substitute for the objectionable peroxide plate as the positive, as he believes that most of the defects of an accumulator are due to the positive plates; he substitutes for this a carbon plate and uses chlorine as a depolarizer; theoretically such a combination should give 1.70 volts; in all the tests he used chloride of zinc as the exciter; among all the combinations which he tried the only one of interest was one in which the depolarizer was Fe_2Cl_6 on account of the constancy; such a battery can be used to advantage in certain cases in laboratories, but its low E. M. F. prevents it from coming into general use; in these cells the resistance increases with the time.

Gas Battery.—An illustration to the paper abstracted in the Digest, Dec. 8, showing the apparatus, is published in "La Nature," Dec. 1; this illustration was not contained in the journal from which our abstract was taken.

Prussian Blue and Berlin Green.—The Goebel process of preparing these substances electrolytically is briefly described in the Lond. "Elec. Rev.," Nov. 30. A solution of yellow prussiate of potash is precipitated by means of a ferrous salt, such as green vitriol, the precipitate being suspended in water and then subjected to electrolysis, yielding Prussian blue; the solution may contain 0.05 per cent. of acid; the precipitate is introduced in the immediate neighborhood of the anode, the contents of both compartments being kept well stirred; the hydrogen liberated is taken up by manganese peroxide, or by organic nitro-compound; when the electrolytic action is protracted, the color becomes faint and the material changes to dark Berlin green.

Gold Extraction.—The Lond. "Elec. Rev.," Nov. 30, contains two more communications on the cyanide process, by Mr. Andreoli; in reply to Mr. Weightman (see Digest last week) he states that the objections to the use of carbon are more serious than that writer thinks; he also believes that the 600-ampere rate would be more efficient than the 60-ampere rate proposed by Mr. Weightman.

Galvanized Wire.—The "Elek. Anz.," Nov. 29, describes a process in which the wire is first passed through a nickel bath and then through a zinc bath, the object being to make the zinc coating adhere more tenaciously than it does with the ordinary hot galvanizing process.

MISCELLANEOUS.

Thermopiles.—In an article by Mr. Brueggemann in the "Elec. Zeit.," Nov. 29, he gives the results of a number of different measurements with the improved form of the Guelcher piles; each consisted of 66 elements, and one of them had been in constant use for two years. The results are given in curves and tables, and among the conclusions arrived at, the following may be given: The internal resistance was about 0.78 ohm; the maximum external output, he shows by experiment, is obtained when the external resistance is equal to the internal; the E. M. F. is directly proportional to the amount of gas used, between pressures from 11 to 34 mm of the water; he suggests regulating them by regulating the supply instead of by using external resistances; he finds that the counter E. M. F. produced by the current is very nearly proportional to the current, but it is so slight that the E. M. F. (as distinguished from the voltage at the terminals) may be assumed to be constant for all currents; he gives curves showing the gradual rise and fall of the E. M. F. after lighting or extinguishing the flame, and finds that the flame should burn about 24 minutes before the maximum E. M. F. is reached, although 90 per cent. of it is reached after 11 minutes; the internal resistance appears to increase with use, at first quite rapidly and then slower, finally becoming a constant; with a pressure of 30 mm of water the E. M. F. was 3.97 volts with a consumption of 164 liters per hour.

Welding.—The "Elek. Anz.," Nov. 18, publishes a few figures relating to the Lagrange & Hoho processes (sometimes called, in this country, the water-pail forge process, in which the metal is heated by immersion in a liquid, while a current passes); the voltage appears to have been 150, and the result referred to rods of iron; it is stated that the best current density was found to be about 32 amperes per sq in. of immersed surface, and the best temperature about 157 deg. F.; (it appears that the maintenance of this temperature is an important factor, as the action is not good when the temperature becomes too high); with an iron rod of 127 sq. mm cross section, the time was 61 seconds and the watt seconds per sq. cm was 691,000; for a cross section of 284 these figures were 80 and 661,300, and for a cross section of 150 they were 58 and 537,200.

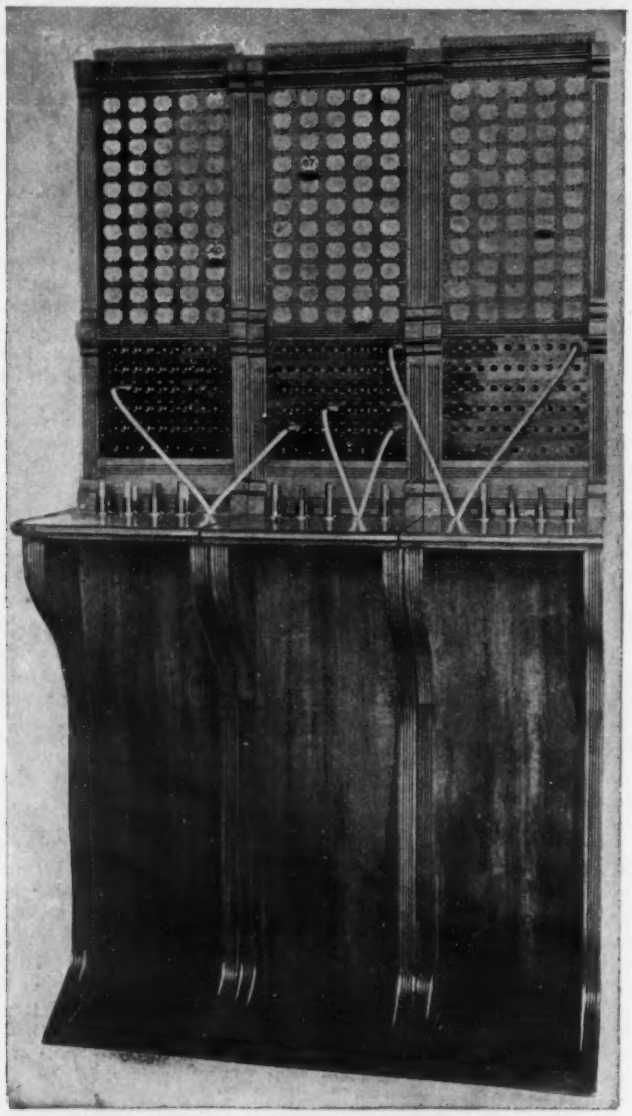
Movable Roof.—The electrical apparatus for operating a removable roof in an auditorium in Paris, is described with illustrations in "L'Elec.," Nov. 24; the roof appears to be on wheels and is in two halves, each of which carriers its motor.

Lightning.—An illustration showing a peculiar freak of a bolt of lightning is published in "Cosmos," Nov. 17; the lightning appeared to have passed down the side of a house along a metallic water pipe, but instead of entering the ground it took apparently a much longer path along the wall, through the hinges of a shutter and thence to ground through an iron grating.

Tachometer. — A good illustration, with description, of a new and ingenious form devised by Mr. Amsler is published in "La Nature," Nov. 17.

Magneto Telephone Exchange.

The Niles Telephone Company, of Niles, Mich., has recently installed the system of the Gilliland Telephone Company, 186 Fifth avenue, Chicago. The plant was constructed by the Gilliland company and its magneto telephone and switchboard used throughout. Mr. Nate, General Manager of the company, who recently returned from Niles, reports that



Switchboard of Magneto Telephone Exchange.

the subscribers to the system are more than pleased with the service furnished.

The exchange was opened with 95 subscribers, and in a letter ordering ten additional instruments the local manager states that the system continues to grow in favor daily.

The switchboard, which we illustrate, embodies some entirely new features. It is simplicity itself, very accurate and remarkably rapid in its work. The board is of 150-wire capacity, being in three sections of 50 each.. The same design can be made in any capacity desired.

A Huge Alternating Generator.

The General Electric Company is now building at its Schenectady Works one of the largest alternating current generators ever constucted. The generator is to be installed at St. Louis, Mo., in the station of the Edison Electric Illuminating Company and will supply current for incandescent and are lighting and for motor service.

In order to secure efficient results for these various uses, the generator is constructed on the "monocyclic" system, recently adopted by the General Electric Company. This system employs a comparatively low frequency of alternations, and the armatures of the generators have special windings adapting them for use on circuits with self-starting current motors.

The generator illustrated (Fig. 1) is of 800-kilowatts capacity, has 80 poles and is to be driven by a Hamilton-Corliss engine at 90 revolutions per minute. On account of the great size of the frame difficulties were to be expected in producing the castings, but thanks to the facilities of the Schenectady works, no trouble was experienced in pouring even the

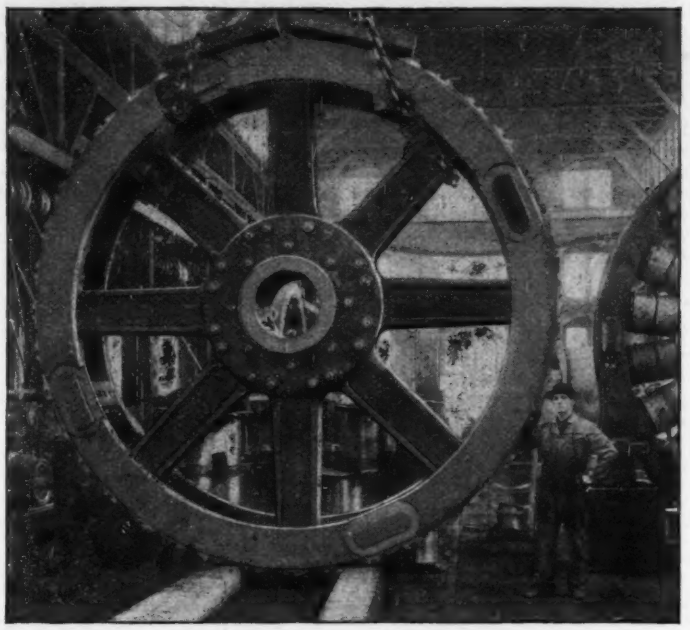


Fig. 1.—800-Kilowatt Generator.

large frame casting shown. This single piece, made up in part of wrought iron embedded in the castings, weighs 35 tons and measures 24 feet over all. The armature is ironclad and is 16 feet in diameter, weighing nearly 100,000 pounds. The armature will be supported on a 22-inch shaft.

Fig. 2 shows also the armature spider before the laminations were placed upon it. An idea of its size may be had by comparing the spider with the 400-kilowatt rotary converter which stands to the right of it.

The completed generator will supply, when at full load, 667 amperes at 1,200 volts, equivalent to 16,000 16-cp lamps.

In this connection it should be stated that the great size of the gen-

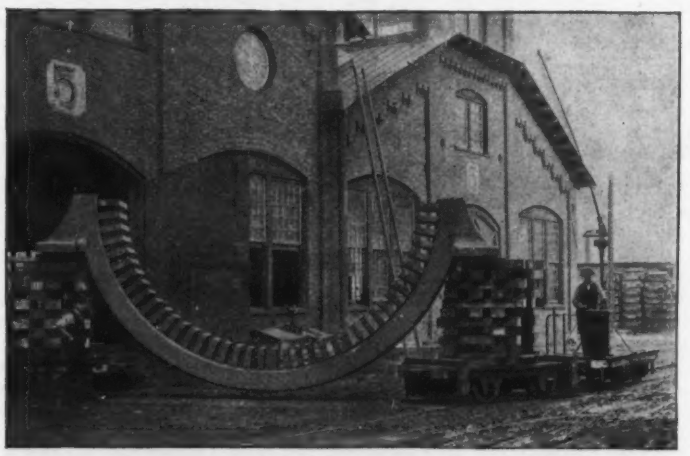


Fig. 2.—Armature Spider of 800-Kilowatt Generator.

erator was necessitated by the requirements under which the machine is to be operated, chief of which is the low speed of revolution.

Electric Traction in Dublin.

By the 1st of May next it is anticipated that the Dublin, Ireland, Southern Tramways Company will have an entire electrical equipment on its lines. The electric lines will consist of eight miles of double track, and the change will also involve an entirely renovated plant. New cars to be lit by electricity will be built.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET

NEW YORK, Dec. 15, 1894.

ELECTRICAL STOCKS still fail to develop particular activity, but when note is made of the sluggishness pervading the whole Stock Exchange list, that ceases to be remarkable. The strength they continue to display is, however, in marked contrast to the weakness marking the course of other comparatively active steam railroad and "Industrial" shares and is the most convincing argument as to the healthy condition of the electrical trade.

GENERAL ELECTRC was a little more quiet this week than is ordinarily the case, but the lack of operations in the stock has not beeen at the expense of quotations. Prices are fully up to recent records, while the 5 per cent. bonds are in more demand than has been observable for some time. Their quotation has accordingly risen about ½ a point. There have been some efforts made to bull the stock on false reports relative to new combinations and agreements. One of these rumors had to do with an arrangement said to have been effected with the Westinghouse Electric and Manufacturing Company looking to the fixing of prices. Another report recently published had it that the Cataract General Electric Company, which has bought machinery from both the General Electric and Westinghouse companies was to be absorbed by the former. It is silly to attempt to boost General Electric stock on any such fake stories. There is enough intrinsic value in the stock to make it worth current quotations, and, once the existing complication in the company's financial status has been arranged for, the stock, to judge from its present shown ability to earn money, will be worth even a good deal more. But it were best in the meantime to let things take their natural course and not influence the stock's value by any such methods. The incident serves to show, however, how artificial the market really is and how little real significance there is in current affairs.

WESTINGHOUSE ELECTRIC common holds its own around 33. The stock was recently marked down on wash sales, but the fictitious character of the transactions were speedily recognized and the orders that made their appearance under 32 caused all offerings to be so freely absorbed that the price quickly went back to current figures. There is no reason for a break in the stock's quotation. The company's business is perfectly satisfactory. It is getting new contracts every week and the outlook is understood to have never been more promising than it is at present. The scrip, too, has risen in value the bidders having been obliged to raise their offer to 97. The preferred shares are now selling ex-dividend but are strong.

WESTERN UNION TELEGRAPH'S statement of earnings and expenses for the last quarter makes a good comparison with the figures for the same period in 1893. All figures are partly estimated, but the statement shows that net earnings inscreased $50,000, the total being estimated at $1,600,000. The actual may be more as the net earnings for the September 30 quarter were $13,563 more than the estimate. Dividends increased $7,000 but the surplus of $165,200 is none the less $43,462 more than was left over in 1893 after making similar provisions. Of course, in view of these improved earnings, the regular dividend of 1¼ per cent. was ordered paid on the stock. A director of the company is quoted as saying after the meeting that the improvement "was due in great part to the larger business South, where earnings have run ahead of 1893. In the West, there has been some improvement, although not as much, while in the East results have been relatively not as good. It is rather an interesting fact that the leased wire business has been better than it was a year ago. There has been quite a demand for this form of telegraphic facility." Knowledge of the favorable character of the report led early in the week to good buying of the stock.

ELECTRICAL STOCKS.

	Par.	Bid.	Asked
Chicago Edison Company	100	127	130
Cleveland General Electric	100	80	90
East River Electric Light Co.	100	—	50
Edison Electric Ill., New York	100	102⅜	103
" " " Brooklyn	100	109	112
" " " Boston	100	127	128
" " " Philadelphia	100	120	125
Edison Ore Milling	100	13	15
Electric Storage Co., Philadelphia	100	39	40
Electric Construction & Supply Co., com.	15	7⅛	10
" " " " pref.	15	7½	10
Fort Wayne Electric	100	2	3
General Electric	100	34⅞	35
General Electric, pref	100	70	72
Westinghouse Consolidated, com.	50	33	34
" " pref	50	51	51½

BONDS.

Edison Electric Ill., New York	1,000	109	110
Edison Electric Light of Europe	190	75	85
General Electric Co. deb. 5's	1,000	91¼	91⅜

TELEGRAPH AND TELEPHONE.

American Bell Telephone	100	200	201
American District Telegraph	100	35	40
American Telegraph & Cable	100	91	92
Central & South American Telegraph	100	102	105
Commercial Cables	100	130	145
Erie Telephone	100	52	53
Gold & Stock Telegraph	100	103	105
Mexican Telegraph	100	180	190
Mexican Telephone	100	75	80
Western Union Telegraph	100	88⅛	89
Ex-div.			
New England Telephone	100	67	69
New York & New Jersey Telephone	100	97	98
Postal Telegraph-Cable	100	50	55

AMERICAN BELL TELEPHONE surprised the financial world by declaring, in addition to the regular quarterly dividend of 3 per cent., payable January 15, an extra one of 1½ per cent. The extra dividend is officially declared "payable out of the surplus earnings of the six months ending December 31." Up to July, 1892, the company had been paying an annual extra divided of $6 per share in July for three years. Beginning with July, 1892, it paid $3 per share extra in January and July up to July, 1894, when no extra dividend was paid, but at the declaration of the next quarterly dividend in September last, an extra dividend of 1½ per cent was declared payable out of earnings of the previous six months. In view of this extra dividend of 1½ per cent. last quarter, payable out of six month' earnings, with no extra dividend since 3 per cent. last January, the street hardly expected anything at this juncture and the 1½ per cent. extra was a gratifying surprise. This extra payment makes 15 per cent. for the year, but the payment of 1½ per cent. extra for two successive quarters gives hopes that the old basis of 18 per cent. per annum will be returned to.

THE FORT WAYNE ELECTRIC CORPORATION'S 6 per cent. debentures, for which the old Fort Wayne Electric stockholders subscribed, are being issued to those who paid subscriptions in full. A dividend of 12 cents a share will, it is announced, be paid January 1st, upon Fort Wayne Trust securities, Series A.

STREET RAILWAY AND ILLUMINATING PROPERTIES common stock rules very strong at 22 bid with one small sale reported at 23. Of the preferred stock, 81,337 shares have been retired to date, $105.72 being paid for the last lot. This leaves 26,863 shares outstanding, which can be drawn at 110. The company is reported to have $200,000 in bank, and it is figured that common stockholders will receive from $40 to $50 per share in the final wind up.

THE EDISON ELECTRIC ILLUMINATING COMPANY, of New York, reports as follows for November. Gross earnings, $145,904, an increase of $24,202 over the gross receipts for November, 1893; operating expenses and taxes $63,613, increase $7,497; net earnings $82,290, increase $16,704. Gross earnings for eleven months are $1,236,016, an increase of $157,647; net earnings $645,782, increase $139,072; accrued interest on bonds, $189,300, the amount of outstanding bonds having increased $750,000 from $3,562,000 to $4,312,000; amount applicable to dividends on $7,938,000 capital stock, $456,482, a decrease of $20,249. The number of incandescent lamps in use at the end of November was 229,471, a gain of 46,406, and arc lamps 3,005, a gain of 682.

BROOKYLN EDISON ILLUMINATING reports $50,018 gross earnings for November; this is $10,088 ahead of last year. Net earnings were 26,109, an increase of $5,615, and the amount applicable to dividends is $28,029, an increase of 8,058.

ERIE TELEPHONE stock is quiet. Net earnings for October are reported to have increased $8,410 over the same month last year.

EDISON ILLUMINATING OF BOSTON is very strong. The stockholders vote December 18 upon a proposition to increase the capital from $425,000 to $3,425,000, the money to be used for improvements and extensions.

THE TRACTION STOCK MARKET is lacking in particular news, speaking from a trading standpoint, though each day brings new evidence of the ever-increasing interest being taken in this class of securities. The various stock exchange authorities are recognizing the demand for traction stocks and are affording increased opportunities for trading in them. The Philadelphia Exchange has given a listing to $3,000,000 common stock and $2,200,000 first mortgage 5 per cent. bonds of the Columbus (Ohio) Street Railway Company and the New York Stock Exchange listed the bonds of the Denver Tramway Company. The electric street railroad has come to be a tremendous factor in the commercial and financial worlds, and its use is daily extending. Earnings of late on many important Eastern systems are reported as falling off a little; the bad weather is responsible for this and quotations are not affected by the showing.

ELECTRIC TRACTION STOCKS.

	Bid.	Asked
Union Ry. Co. (Huckleberry)	130	136
Brooklyn Traction pfd.	66	69
" " common	14½	15½
Long Island Traction	14	14½
Rochester St. Ry	38	40
Columbus St. Ry	45	50
Louisville St. Ry. pfd	87	88
" " " common	37	39
Cleveland Electric Ry.	45	47
Cleveland City Ry.	68	70
North Shore Traction	22	—
New Orleans Traction	59½	—
Worcester Traction pfd	82	86
" " common	14½	16
Metropolitan Traction Philadelphia	107¼	107⅜
Philadelphia Traction	101	101⅛
People's Traction	55	55⅛

BONDS.

	Bid	Asked
*Union Ry. 1st. mtge 6s	105	108
*Westchester Electric 1st. m. 5s	98	101
Rochester St. Ry. 1st. 5s	95	97
*Columbus St. Ry. 1st 5s	89	92
Columbus Crosstown 1st. 5s	95	97
Binghamton Railroad Co. 5s	99	100

*With accrued interest.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
253 Broadway, New York, Dec. 15, 1894.

MR. FRANK RIDLON, of Boston, was in the city last week.

MR. C. W. HOLTZER, of the Holtzer-Cabot Electric Company, of Boston, paid a visit to this city last week.

MR. CHARLES HUNTLEY, of Buffalo, was registered at the Waldorf last week.

MR. A. MITCHELL HALL, general manager of the C. & C. Electric Company, 143 Liberty street, has gone West on a business trip.

MR. L. WARFIELD, of the Detroit Electrical Works, was in New York during the week, and called at the office of The Electrical World.

MR. J. W. GODFREY, formerly manager of the New York Insulated Wire Company, 15 Cortlandt street, New York, has taken offices at the same address, room 38.

MR. WILBUR F. HANKS, advertising representative of the "Electrical Engineer," has just returned from Willimantic, whither he had gone to attend the funeral of his brother.

MR. W. H. McKINLOCK, the enterprising president of the Metopolitan Electric Company, Chicago, visited the office of The Electrical World while on a business visit to the East during the present week.

MR. J. A. MACHADO, 203 Broadway, New York City, sole selling agent of Waddell-Entz dynamos and motors, has been awarded the contract for the light and power plant for the new building of the New York Clearing House. Direct connected generators will be used.

THE RECENT DEATH of Mr. W. E. Kelly, president of the National Water Tube Boiler Company, of New Brunswick, N. J., removes a familiar figure from business circles, and one whose loss will be much regretted by an unusually extended circle of friends.

DAVID CHALMERS, 114 Liberty street, New York, agent of the Holtzer Cabot Electric Company, Boston, met with a painful accident last week. Whilst closing his safe his right hand was caught in the jams of the door and so injured as to render the hand useless for some time.

MR. C. O. BAKER, JR., master of transportation of the National Electric Light Association, has just returned from a four weeks' trip in the West and North, and states that every one is enthusiastic over the coming electric convention to be held in Cleveland, and that the indications are that it will be the largest ever held.

THE INTERIOR CONDUIT AND INSULATION COMPANY, 44 Broad street, New York, reports that the American Electric Supply Company, of Buffalo, N. Y., has ceased to be its agent. The American Electric Supply Company, it states, is one of the oldest agents of the Conduit company, and the relations between the two companies have always been of the pleasantest character. The Conduit company, however, has found that its interests are antagonized when represented by a construction house, and have consequently changed its policy and in the future will be represented by supply houses not engaged or financially interested in the construction business. The American Electric Supply Company could not afford to give up the large construction business it enjoys, and hence followed a friendly termination of its agency relations with the Interior Conduit and Insulation Company.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
936 Monadnock Building, Chicago,
December 15, 1894.

THE NASHOLD CLEAT, manufactured by the Nashold Cleat Co., Chicago, continues to grow in favor, if the inquiries and orders from all parts of the country are any evidence. Nearly every city in the nation has sent requests for samples of this clever device.

PROF. J. P. BARRETT returned during the week from a trip east. The new city lighting contract has not been let as yet, but the Professor promises that things will be all right in a very short time. He is enjoying good health and is as jolly as ever.

W. H. McKINLOCK, another of Chicago's leading citizens, returned from the east during the week. It is curious that a man who is always busy in Chicago cannot remain away any great length of time. Mr. McKinlock is no exception, for he is kept right at it with the ever-increasing business of the Metropolitan Electric Company.

MR. F. A. HAMILTON, member A. I. E. E., recently gave an interesting lecture before the electrical students of Armour Institute on the subject of "Submarine Cables and Cable Laying." It was fully illustrated by lantern slides, made from original sketches and charts. Mr. Hamilton was for sixteen years Electrician in Chief to the Anglo-American Telegraph Company.

THE NUTTING ELECTRIC COMPANY is pleased to announce that all internal differences have been settled, and it is now in a position to offer its friends and the electrical trade the perfected Nutting arc lamp. This, it claims without fear of contradiction, will be found the best alternating arc lamp on the market, and it has issued a handsome pamphlet describing the lamp in detail. The address of the company is 128 South Clinton street.

THE CENTRAL ELECTRIC COMPANY seems to display the qualities of the evergreen. By degrees its great store on Adams street has become more and more settled until it is now in admirable working order. Everything is so arranged that an order goes through its course with certainty and swiftness, and details are so nicely taken care of that nothing goes amiss. Its new supplementary catalogue contains many new and valuable additions to what is conceded to be one of the best lines of supplies and specialties ever arranged under a single house.

THE DEARBORN ELECTRIC COMPANY, of Chicago, has succeeded to the business of T. C. Rafferty & Company, and in the new and commodious quarters which it has secured at 19 Quincy street, opposite the Great Northern Hotel, it will be better able to handle promptly the largely increasing business of the past few months. The officers of the new company are as follows: T. C. Rafferty, president; Chas. Merser, vice-president and treasurer, and J. P. Rafferty, secretary. A new illustrated catalogue is in the hands of the printer at the present time which covers fully the various valuable agencies which the company has, as well as a full line of general supplies.

News of the Week.

NEW INCORPORATIONS.

THE AVALON ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $500.

THE BEN AVON ELECTRIC LIGHT COMPANY, Ben Avon, Pa., has been incorporated with a capital stock of $500.

THE BEAVER AND GLADWIN TELEPHONE COMPANY, Gladwin, Mich., capital stock $250, has been incorporated by Eugene Foster, J. M. Schaffer, S. S. Townsend and others.

THE TREMONT IMPROVEMENT COMPANY, Portland, Me., capital stock 1,000, has been formed to build and operate an electric light, heat and power plant. The interested parties are Howard L. Rogers, Charles F. Wallace, Boston, Mass., and Josiah H. Drummond, Jr., Portland, Me.

THE CASTLE ROCK ELECTRIC COMPANY, Castle Rock, Wash., capital stock $1,000, has been formed to operate an electric light and power plant. The promoters are C. E. Forsythe, A. S. Forsythe and H. V. Gates.

THE VALPARAISO GAS AND ELECTRIC COMPANY, Valparaiso, Ind., capital stock $120,000, has been formed to supply gas and electric lights. The incorporators are Jesse Scribner, Otis E. Turner and Oscar H. Olsen.

THE CHATHAM ELECTRIC LIGHT AND POWER COMPANY, Savannah, Ga., capital stock $25,000, has been formed to operate an electric light and power plant. George Parsons, Henry Parsons, James J. Johnson and John N. Harriman are the promoters.

THE PEOPLES' ELECTRIC RAILWAY, Terre Haute, Ind., capital stock $100,000, has been formed to construct and operate an electric railway. Andrew J. Crawford, James P. Crawford, George J. Hammerstein, Edwin Ellis and Herman Halman, Sr., are the promoters.

THE KEOSAUQUA CANAL AND WATER POWER COMPANY, Keosauqua, Ia., has been formed to utilize a water power and maintain same for generating electricity, or compressed air. Ben Johnson, W. M. McIntosh, H. E. Duckworth, C. W. Casner and James Anthony, Keosauqua, are the organizers.

THE DENISON ELECTRIC LIGHTING AND POWER COMPANY, Denison, Iowa, capital stock $20,000, has been formed to establish and maintain an electric light and power plant at Denison. J. B. Romans, E. Culick and J. N. Bradley, Denison, Iowa, are the promoters.

THE NIAGARA ENGINEERING COMPANY, Model City, N. Y., capital stock $10,000, has been incorporated to build and equip electric light, railway, heat and power plants, and to make and sell the necessary apparatus. L. B. Dorr, C. C. W. Nobles and L. E. Squier, of Buffalo, N. Y., are interested.

THE PADUCAH ELECTRIC COMPANY, Paducah, Ky., capital stock $40,000, has been incorporated for furnishing arc and incandescent electric lights, power for moters, elevators, etc. Elbridge Palmer, R. Rowland, J. L. Friedman, J. W. Keiler, W. A. Gardner, F. M. Fisher and A. E. Einstein are interested.

THE NEW MEXICO ELECTRO-CHEMICAL REDUCTION COMPANY, Chicago, Ill., capital stock $100,000, has been formed to mine, reduce, refine and treat ores and minerals bearing gold, silver or other precious metals. The organizers are Otto R. Barnett, Clenn C. Plumb and Clark Edward Ridpath.

THE FERRIS ELECTRIC AND MANUFACTURING COMPANY, Cedar Rapids, Iowa, capital stock $10,000, has been formed to make, buy, sell, lease and repair electrical apparatus or appliances and to equip and operate same. W. J. Ferris, Chicago Ill.; Thomas Ferris and Robert Ferris, of Cedar Rapids, are the interested parties.

THE PHOENIX ELECTRIC SUPPLY COMPANY, Warren and Youngstown O., capital stock $1,000, has been formed to deal in electrical supplies of all kinds, to manufacture electric lamps, and to supply electric light and power, etc. Warren B. Swager, Warren L. Swager, Wm. F. Corbin, Herbert H. Miller and David W. Campbell are the promoters.

THE TRENTON TRACTION COMPANY, Trenton, N. J., capital stock $500,000, has been incorporated by E. J. Moore, Philadelphia, Pa.; Thomas C. Barr, Newark, and Francis M. Eppley, of Orange, N. J., and others, for the purpose of leasing and operating the lines of the Trenton Passenger Railway Company, which controls franchises in nearly every street in the city.

THE PHOENIX ELECTRIC SUPPLY COMPANY, Warren, O., capital stock $1,000, has been incorporated by Warren B. Swager, Warren T. Swager, William F. Corbin, Herbert M. Miller and David W. Campbell, to deal in electrical supplies and incandescent electric lamps; also to act as agent in selling for others electric lamps and supplies of all kinds, and in general to engage in the business of dealing in electric lamps and supplies.

THE NEW JERSEY AND DELAWARE ELECTRIC FORGING COMPANY, Newark, N. J., capital stock $250,000, has been incorporated to rent, furnish and lease apparatus for forging, welding, heating, etc., iron, steel, copper or other metals through the medium of electricity in a liquid solution, etc. Frederick A. Nichols, Arlington, N. J.; Barnard J. Fredericks, New York, and Edward Kenny, Newark, N. J., are the organizers.

TELEGRAPH AND TELEPHONE.

RICHMOND, VA.—Samuel Regester and associates have applied to the city for a telephone franchise.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company will remodel and improve its plant.

MARSHFIELD, WIS.—The National Telephone Company has just completed the work of putting in an exchange.

AUSTIN, TEX.—The Southwestern Telegraph & Telephone Company will enlarge and otherwise improve its plant.

GRAND RAPIDS, MICH.—The Harrison Telephone Company has applied to the Council for a franchise to build lines in Detroit.

SALT LAKE CITY, UTAH.—The Rocky Mountain Bell Telephone Company is making extensive improvements in Montana, among them being the construction of 30 miles of double circuit lines to Marysville.

GOSHEN, IND.—F. L. Middleton, of Elkhart, will meet a committee from the Common Council at Goshen in reference to establishing a new telephone exchange at that place similar to the one contemplated at Elkhart.

ASBURY PARK, N. J.—A local telephone company will be organized in Asbury Park. At a meeting of subscribers this course was unanimously decided upon. The new company will have a capital of $25,000. Mayor Ten Broeck may be addressed.

LOCKPORT, N. Y.—The Citizens' Mutual Telephone Company has been organized to construct a telephone line between Lockport and Niagara Falls. The capital is $15,000, and the directors are Joseph A. Ward, Wm. V. Trevor, Hiram K. Wickes, Theo. H. Van Horne, and others of Lockport.

FULTON, N. Y.—The Fulton Valley Telephone Co. has been organized to connect Middleburg with Fulton, Fultonham, Breakabaen, and Blenheim, all in Schoharie County, by telephone. The capital is $500, and the directors are Albert L. Rosekrans, Charles W. Vrooman, and Charles Bouch, of Fulton, and others.

ELECTRIC LIGHT AND POWER.

EUFALA, ALA.—Address the Mayor regarding the establishment of an electric light plant.

CLINTONVILLE, WIS.—Address the city clerk concerning an electric light plant to be established.

MEMPHIS, MICH.—Thomas Clegg, of Memphis, is interested in establishing an electric lighting plant.

HEMPSTEAD, TEX.—It is reported that an electric light plant and a water works system will be built.

MERRILL, WIS.—The Merrill Railway and Lighting Company is adding a new $10,000 storage battery.

NEOSHO, MO.—Owen Ford, of St. Louis, who lately obtained an electric light franchise, is arranging to erect a plant.

THOMASVILLE, GA.—The Thomasville electric light plant has been purchased by John H. Davidson and Remur McIntyre.

HAMMOND, LA.—W. D. St. Clair is to establish an electric light plant, and a portion of the machinery has already been purchased.

BAYFIELD, WIS.—Bayfield City has come into possession of the water and electric light companies, both being purchased by the city.

CUMBERLAND, MD.—One of the buildings which the Baltimore & Ohio Railroad Company is constructing will contain an electric power plant.

FAYETTEVILLE, N. C.—It is reported that the Council is considering the question of lighting the streets by electricity. W. S. Cook is Mayor.

OSHKOSH, WIS.—E. E. Stevens, W. F. Grunewald and F. H. Josslyn are looking for a site for the location of J. K. Tillotson's new power house.

ANDERSON, S. C.—The Anderson Electric Light and Power Company has purchased water power at High Shoals, and will remove its plant to that place.

GREEN BAY, WIS.—The Green Bay & Ft. Howard Electric Light Company has filed an amendment to its articles increasing its capital stock to $60,000.

ROCHESTER, N. Y.—The Board of Supervisors have authorized the Committee on Courthouse and Jail to procure estimates for an electric lighting plant.

WEEDSPORT, N. Y.—The Board of Trustees of Weedsport has granted a franchise to an electric light company, which agrees to furnish 35 arc lights for $1,500 per year.

MOORESTOWN, N J..—The Moorestown Electric Light Company has issued a notice to its patrons to the effect that, after January 1, the price of light would be increased 25 per cent.

COEYMANS, N. Y.—Plans are in preparation for the erection of an electric light pant and an electric railway from this place to Rensselaerville, and a proposed further extension to New Baltimore.

MONROE, MICH.—At a meeting of the Common Council bids for lighting the city by electricity were opened. The contract was let to the Monroe Gas Light Company. The new plant will be installed by them.

WINEMAC, IND.—The Winemac Electric Light & Power Company has been incorporated with a capital stock of $10,000. J. H. Weaver, I. V. Smith, E. A. Clelland, M. A. Dills and George Muns, are interested

DUNMORE, PA.—At the Council meeting a communication was received from the Electric Light Company offering to provide all night lights at 25 cents each provided the borough would enter upon a five years' contract.

E. ORANGE, N. J.—The building which Mr. W. H. Allen will shortly erect on Harrison street, corner of the railroad, is to be lighted by electricity from a dynamo on the premises. Mr. S. W. Whittemore is the architect.

IRVINGTON, N. J.—Citizens are talking of organizing a company for the purpose of supplying the village with electric light and power. A majority of the business men and taxpayers favor arc lights for the center of the village.

LESTERSHIRE, N. Y.—At a meeting of the trustees of the village, the advisability of erecting its own electric light plant was considered, but they concluded that it would be economy to obtain the lighting from the plant in this city.

HAMILTON, MO.—An informal meeting of the City Council was held, and the subject of electric lights for the city discussed and favorably considered. The conclusion was reached, however, that the matter would have to be submitted to a vote of the people in order to give the Council proper authority to grant a permanent franchise, and provide funds for the payment of contingent expenses.

LYNCHBURG, VA.—The City Council, at its meeting, rescinded its recent action granting a five years' contract to the Lynchburg Electric Company for lighting the city, and referred the matter to a committee to advertise for new bids. This question has created an excitement in the community, it having been alleged that influences had been brought to bear by the Lynchburg Company to secure the contract. Electrical experts from various sections of the country have figured in the controversy.

THE ELECTRIC RAILWAY.

CHESTER, PA.—The Chester and Media Electric Railway ordinance has been adopted.

BALTIMORE, MD.—The City Passenger Railway Company will ask permission of the City Council to extend its tracks.

MORRISTOWN, N. J.—Citizens of Morristown are talking over a proposition to build a system of street car lines in that city.

RUTHERFORD, N. J.—The Union Traction Company has made a formal application for a franchise to the Union Township Commissioners.

SYRACUSE, N. Y.—The Syracuse Street Railway Company will erect a new power house on Tracy street to cost $20,000.

RENNSELLAERVILLE, N. Y.—A company proposes to construct a rural electric road from Rennsellaerville to Ravenna, a distance of 20 miles.

PADUCAH KY.—The Paducah Electric Company has purchased the Citizens' Railway, and it is stated, will rebuild it as a trolley road. Eldridge Palmer and R. Rowland are interested.

PALMYRA, N. J.—The Township Committee has issued a call for a meeting of the citizens to consider the application of the West Jersey Traction Company for right-of-way through the town for a trolley line, which it proposes to operate between Camden and Florence. The consents of the property owners have been secured.

PROVIDENCE, R. I.—At a meeting of Common Council a report was received from the Committee on Railroads relative to a cross town line on the west side. In it was stated that the Union Railroad Company favors a belt line.

FALL RIVER, MASS.—F. W. Stevens and others have petitioned for authority to construct a street railway between Fall River and Providence, to be operated by electricity.

NIAGARA FALLS, N. Y.—A meeting has been held by the promotors of the scheme to run an electric road along the bank of the river to Lewiston, and the initial steps taken to secure right of way.

DETROIT, MICH.—The Detroit Railway Company has been granted a franchise by the Common Council to construct and operate about 20 miles of electric street railway. It will commence work at once.

BALTIMORE, MD.—The Baltimore Traction Company is considering the idea of extending one of its divisions to Clifton Park. Hon. Frank Brown is president.

PITTSBURGH, PA.—A new electric road is to be built from East Ohio street to Spring Hill, Allegheny. H. W. Ahlers, W. H. Hespenheide and others are stockholders.

NEWARK, N. J.—The Suburban Traction Company is in the hands of a receiver, Watson Whittlesey. It has an indebtedness of $1,500,000, and its principal creditor is the American Loan & Trust Company, Boston.

SEVERN, MD.—The Baltimore, Severn Park & Annapolis Electric Railway Company will locate its power plant at Severn Park. The incorporators are Henry Y. Brady, G. H. White and David S. Collett, of Baltimore.

LA CROSSE, WIS.—Rev. Father White, S. W. Anderson, H. J. Hogan and others met with Messrs. Cargill, Edwards and Gund, of the street railway with regard to extending the railway on Market street to the Catholic Cemetery.

WINDSOR, N. Y.—There is some talk of connecting Windsor and Binghamton with an electric road. Joseph Gardam, of New York, is obtaining signatures of Jefferson property holders for the right of way for a proposed electric railway.

BALTIMORE, MD.—John Hubner, of Catonsville, is among the capitalists interested in building an electric road from Baltimore to Cantonsville and Ellicott City, under the title of the Edmondson Avenue, Catonsville & Ellicott City Road.

HINSDALE, VT.—There is a strong feeling in Hinsdale favoring an electric railway from that place to Brattleboro, and in all likelihood an application will go to the Legislature this winter for one to be authorized from Ashuelot to this place.

NEW HAVEN, CONN.—The New Haven Street Railway Company is negotiating for the purchase of the Edgewood Avenue Company's lines, which consist of about seven miles of tracks. The price fixed is said to be between $100,000 and $125,000.

BALTIMORE, MD.—The City & Suburban Railway Company has permission to extend its York Road electric line through the northeastern suburbs to Homestead, near Clinton Park. The distance is about one mile. Nelson Perin is president.

GREENSBURG, PA.—A franchise has been granted by the Borough Council to the Greensburg, Jeanette, Turtle Creek & Pittsburg Electric Street Railway Company for right of way through Greensburg. The capital stock of company is $150,000.

DE LAND, FLA.—A stock company is to be organized to build an electric road between De Leon Springs, De Land and Orange City, and the citizens of De Land are to subscribe $40,000 of the stock. About 150 shares of the stock have been taken.

NORRISTOWN, PA.—The Shepp Bros., who have begun work on the extension of their trolley road from Norristown to Royersford, have secured a franchise from the Perkiomen and Reading Turnpike that practically gives them the whole route.

NIAGARA FALLS, N. Y.—The Cataract Electric Company is to have a trolley system constructed from Niagara Falls to Tonawanda early in the spring, and inventors of the different methods of propulsion by electricity will be invited to test their schemes.

THE SIDNEY ELECTRIC RAILWAY COMPANY, Sidney, O., capital stock $100,000, has been formed to construct and operate a railway in Sidney, thence to Loramies, thence to Minster, O. Charles Timeus, John Loighlin, I. H. Thedieck, William Piper and John H. Wagner are the interested parties.

ANDERSON, IND.—The Gas Belt Electric Street Railway Company has awarded a contract to a Chicago company for the construction and equipment of the electric road, and are bound by contract to have it ready for operation by the 15th of August, 1895.

SEDALIA, MO.—D. C. Metsker, Superintendent of the Electric Railway, Light & Power Company, has stated that it will build nearly three miles of line early in the spring of 1895 which will be an extension of the present road. No contracts have been let as yet.

FORT WORTH, TEX.—Morgan Jones, Vice-President of the Fort Worth Street Railway Company, has stated that the company will rebuild most of this line, also the North Side road, and relay them with 56-pound steel rails. About 13 miles of line will be covered in this way.

BATAVIA, N. Y.—Batavia may have a street railway. The Aldermen have decided to give A. B. Wilgus a franchise for the construction of an electric street railway in Batavia, and Mr. Wilgus promises to have at least three miles of road constructed and in operation within a year.

NILES, O.—The Mahoning Valley Electric Railway has been incorporated with a capital stock of $150,000. The road will run from Niles to Youngstown, passing through Girard, with headquarters at Niles. G. E. Harrick, Andrew Squire and A. Anderson, of Cleveland, are the incorporators.

POTTSTOWN, PA.—The Ringing Rocks Electric Railway Company, which now runs to Ringing Rocks, three miles north of Pottstown, is making preparations to extend its line to Boyertown by way of the Limerick and Colebrookdale turnpike. The extension will be completed early next spring.

DETROIT, MICH.—A number of Detroit capitalists and pushers of new ideas have quietly formed a syndicate for the purpose of building an electric railway from the dividing line between Wayne and Oakland Counties, through Birmingham to Pontiac. E. W. Voigt, the brewer, is at the head of the syndicate.

THE GRANT STREET ELECTRIC RAILWAY COMPANY and the Raimer Avenue Electric Railway Company, both of Seattle, Wash., are now operated under the management of Receiver W. J. Grambs, the Seattle representative of the Northwest General Electric Company.

CRAWFORDVILLE, IND.—A contract has been closed between the Anderson & Marion Electric Railway Company, and C. E. Loss & Co., Pullman Building, Chicago, for building the line for $525,000. It will connect towns having 75,000 population, passing thorugh Alexandria, Gas City, Somitville and Fairmont.

ELIZABETH, N. J.—The New Jersey Traction Company has finally secured a franchise from the Clinton Township Committee of Newark to lay tracks in the center of Frelinghuysen avenue, to connect with the Elizabeth branch. The construction of the road from Newark to Elizabeth will be begun at once. It is now thought that Elizabeth will have trolley cars before February 1.

BALTIMORE, MD.—G. Howard White, H. T. Brady, and David S. Collett, of Baltimore, are interested in forming a company to build an electric road from Baltimore to Annapolis, by way of Severn Park. The trolley system will be used, and $250,000 placed as capital of the company. The distance is about 28 miles.

NEWTON, MASS.—It is given out on excellent authority that the West End road can at last see its way clear to establish a circuit street railway system from Boston through Cambridge and Watertown to Newton, and returning from the latter point through Brighton and Allston and over the Brookline boulevard to Boston.

WARREN, O.—John E. McVey has been granted a franchise by the Trumbull County Board of Commissioners, for the construction and operation of a line of electric street railroad from Niles to the Southern line of the county. The road is to be in operation by Sept. 1, 1895, and the power-house is to be located in Trumbull County.

ENGLEWOOD, N. J.—The electric railway which is projected from the ferry to Englewood, an entirely new enterprise, is now being surveyed by the engineers in order that the most feasible route up the hill may be established. This portion of the line is independent of the surface connections which have already been determined upon.

THE STATEN ISLAND ELECTRIC RAILROAD COMPANY, New Brighton N. Y., capital stock $1,250,000, has been formed to build, maintain and operate a street surface railway 22 miles long in Richmond county, N. Y. The interested parties are George B. M. Harvey, Milton L. Boudon and Eugene R. Leland, all of New York.

THE BARNES HEIGHTS AND CORNELL MOUNTAIN ELECTRIC RAILROAD, in Portland, Ore., recently went into operation again, after having been shut down for some time. Current is taken from the wires of the Portland Consolidated Street Railway Company's system, which is generated at the Union Power Company's central station.

SAN FRANCISCO, CAL., citizens are agitating the formation of an organization to prevent the monopolization of the streets by the Consolidated Railway Company through its numerous franchises. The trolley system in general is also opposed by many citizens on account of the numerous accidents common to surface roads in large cities.

THE OLYMPIA LIGHT AND POWER COMPANY, of Olympia, Wash., recently purchased the following from the Northwest General Electric Company for the equipment of its new electric railway line, which will be used to transport material to the new State Capitol building now being erected in Olympia. One 30-hp freight car, with two G.-E. 800 car equipments, with type K controllers, and new line material sufficient for one mile of new trackage.

THE BROOKLYN, NEWTOWN AND BOWERY BAY ELECTRIC RAILWAY received a franchise on December 12 from the Board of Highway Commissioners of the township of Newtown, for the construction of an electric railway from Greenpoint to the Lutheran Cemetery and Bowery Bay. About ten miles of track will be constructed and twenty cars operated. The president is A. C. Combes, of Newtown, and the engineer E. B. Gallaher, 253 Broadway, New York, who is also the engineer of the new Peekskill road

TRENTON, N. J.—The Trenton Traction Company has been incorporated with a capital of $500,000. Among the incorporators named are E. J. Moore, the head of the Philadelphia Traction Company, and Thomas C. Barr, formerly head of the Consolidated Traction Company, of Newark and Jersey City. The new company will lease the lines of the Trenton Street Car Company.

COLUMBIA, PA.—At a regular monthly meeting of the Borough Council it was resolved that whenever the Columbia, Ironville & Mt. Joy Street Railway Company demonstrates its purpose and ability to construct the proposed railway, and complete it to the borough lines, the Council will grant it such reasonable street franchises as are necessary for its business and accommodation.

CAIRO, N.Y.—An electric railway project is being pushed at Cairo. The Road Commissioners called a public meeting in order to find whether it would meet a favorable reception. Joseph Gardam, of 98 John street, New York City, representing a number of capitalists, was present to explain the matter, and an attempt is being made to secure the consent necessary to the issuing the franchise.

RAVENA, N. Y.—Considerable interest is being manifested in the villages along the thoroughfare running through the towns of Coeymans, Westerlo and Rensselaerville, in regard to the proposed electric road from the latter place to Ravena, a distance of 20 miles, and connecting with the West Shore Railroad. It is understood that Mr. F. C. Huyck, of Rensselaerville, is one of the prime movers.

FLUSHING, L. I.—A petition has been signed by property owners on Amity street protesting against the board of trustees granting permission to any railroad to lay tracks, string wires, or run cars on that street. The protest is the result of the fact that at the last meeting of the trustees the Flushing & College Point Electric Railway Company made application to extend its lines through the village.

PITTSBURG, PA.—It is said that a new street railway is contemplated between this city, Verona and Oakmont, and it is reported that the Duquesne Traction Company has its eye on the franchise, and also that the Citizens' Line is after the same thing. The Sharpsburg Passenger Railway is pushing its lines towards the coveted boroughs, and they may get in ahead of either of the two companies.

NEWBURGH, N. Y.—At a meeting of the Commissioners of Highways the application will be considered of the Walden & Orange Lake Railroad Company, for permission to construct and operate an electric railroad over the South Bank road from the western end of the Newburgh & Orange Lake Electric Railroad to the boundary line of the town of Newburgh and the town of Montgomery, a distance of about 1½ miles.

NEW BRITAIN, CONN.—The Central Railway & Electric Company has awarded to Redfield & Sons, of New Haven, the contract for grading and filling in the line to Berlin. A contract was also awarded to Frederick T. Lay, of Springfield, Mass., for laying the track and ties for the new road. All this work is to be pushed to completion as soon as possible. Engineer Caldwell surveyed another route for the electric line to Hartford, going straight out East Main street, etc.

BROOKLYN, N. Y.—The Batavia & Northern Railway Company was incorporated to construct a railroad eighteen miles long, to be operated by steam or electricity, between Albion, Orleans County and Batavia, in Genesee County. The capital is $352,000 and the directors are: Geo. A. Wingate, Jacob Cole and Wm. H. Hazard, of Brooklyn; Robert Avery and James H. Cox, of New York City; Ernest Wende, of Buffalo, and others. The principal office of the company will be in Brooklyn.

WAUKEGAN, ILL.—The Bluff City Electric Railway Company has completed its organization with Homer Cooke, president, T. H. Lindsay, treasurer, S. D. Talcott, secretary, H. Cooke, G. R. Lyon, S. D. Talcott, N. A. Steele, H. F. Powell, W. H. Dodge and T. H. Lindsay, directors. The capital stock is $200,000 and a few shares are already subscribed. The company intends to secure the right of way and build the system itself, if possible, or assist any responsible party to build it, that the city may secure the benefits of rapid transit.

CRISFIELD, MD.—A company was incorporated by the last legislature and a charter granted to lay off and construct a railway to commence at the railroad pier at this place and extend to a point on Pocomoke Sound at or near Sterling's Point, a distance of two and a half miles. A meeting of the incorporators has been held and T. S. Hodson was elected president, O. P. Byrd, secretary, and Isaac H. Tames, A. Lincoln Dryden and W. A. Tull, directors. Offers have been made by a syndicate in New York to construct and equip the road. It is thought that electricity will be used.

LOCKHAVEN, PA.—At a meeting of the citizens of Nippenose Valley, held Tuesday evening, in the interest of the proposed new trolley line, officers and directors were elected as follows: Directors, G. W. Clark, Sr., Levi Gann, Jonas Moore, Henry G. Eck and others. Officers: J. B. Denworth, president; Jonas Moore, secretary; John Engler, treasurer. Resolutions were passed that in building the road through Nippenose Valley, it be located to connect with and pass through Jamestown, Oval and Collums, to the central part of the Valley.

LANCASTER, PA.—Application will be made to the Governor of Pennsylvania on Dec. 18th by John J. Patterson, William B. Given, J. Hay Brown, John S. Skiles, Silas M. Patterson and others, for a charter for an intended incorporation to be called the "Keystone Traction Company," the character and object of which is the construction and operation of motors and cables, or other passenger railways, and the necessary apparatus for supplying the same, and of contracting with passenger railway companies to construct, lease and operate motors, cables and other appliances necessary for the traction of their cars.

BENNINGTON, VT.—The bills for a charter for the Bennington Electric Railway and the Bennington and Woodford Electric Railroad have passed both branches of the Vermont Legislature and received the Governor's signature. Some preliminary steps toward building the Bennington and Woodford line will probably be undertaken this winter. The proposed Bennington electric railway is nine miles long and of light grades, and will connect with the Hoosick Electric Railway at Walloomac via North Bennington. It is confidently believed that the road will be built. Jos. A. Powers, of Lansingburgh, N. Y., can probably give information.

PHILADELPHIA, PA.—All doubt of a trolley line around and through Fairmount Park was settled when the Park Commissioners adopted the amended route. So soon as the Committee on Plans and Improvements approve the plans the work of construction will begin, and it is expected to be in operation by July 1, of next year. The road is to be 6 miles in length, and will include a stone and steel bridge, 1,300 feet long, which will cross the Schuylkill River opposite Strawberry Mansion, and which Wm. Wharton, Jr., to whom the license for the road was granted, estimates will cost $400,000. The total cost, including bridge and equipment, will be about $1,000,000.

Miscellaneous Notes

AN INVENTOR'S SUIT.—An inventor of Pittsburg named James S. Zerbe has sued the Westinghouse Electric and Manufacturing Company for $400,000 for alleged infringement of a "sliding bar incandescent lamp socket" patent.

THE MANUFACTURERS ASSOCIATION of Cincinnati, Ohio, in order to promote the prosperity of the manufacturing interests of the entire country, and appreciating the importance of concerted action, has sent to the officers of all commercial exchanges in the United States supposed to take cognizance of the interests of manufacturers, a circular inviting representation at a conference of manufacturers, which will be held in the city of Cincinnati, on the 22d day of January, 1895, for the purpose of a general interchange of views looking to the formation of a National Association of Manufactures, which shall embrace among its purposes: 1st. The advocacy of carefully considered legislation, to encourage industries of all classes throughout the country. 2nd. The discussion of ways and means whereby trade relations between the United States and foreign countries may be developed and extended. 3rd. The establishment in South American capitals and other desirable points of permanent expositions for the display of American products. 4th. Such other topics as may be agreed upon by the Convention. It is desired that this Convention shall be non-political, non-partisan and non-sectional. The invitation is without limit as to number of attendants, and is cordially extended not only to accredited delegates from organized exchanges, representing manufacturing interests, but to any individual manufacturer who may have the promotion of the general good by organized effort at heart.

Trade and Industrial Notes.

THE GILLILAND TELEPHONE COMPANY 186 Fifth Avenue, Chicago, is meeting with much success in the installation of its magneto-telephones and

switchboards. It has received orders for exchanges of from 50 to 500 instruments.

T. J. MURPHY & CO., marble and slate manufacturers for electric purposes, 136 Liberty street, New York, have been very busy enlarging his factory He reports business very lively, and is bringing out some new designs of switchboards, etc.

MR. L. W. SWEET, 34 Maiden Lane, New York, proprietor of the engine stop apparatus, is much elated over the success he is having with his device. He is putting in as many as he can turn out, and receiving some very flattering testimonials from first-class people.

THE CENTRAL ELECTRIC COMPANY, 173 Adams street, Chicago, has issued a supplement to its general catalogue, which carries the folios from 527 to 634. The addition comprises the latest specialties and improvements, being up to date in every department.

THE MANHATTAN ELECTRICAL SUPPLY COMPANY, 32 Cortlandt street, New York, has issued a second edition of its very complete catalogue of telephones. Many different telephone outfits are illustrated and described, with remarks as to the special use of each one.

RUMSEY & COMPANY, Seneca Falls, N. Y., has issued the 49th edition of their elaborate catalogue of pumps and hydraulic appparatus, containing no less than 172 large pages of descriptions and illustrations of hand power pumps and hydraulic and pumping machnery for all purposes.

THE MIANUS ELECTRIC COMPANY, Mianus, Conn., has issued an attractive catalogue of its interior and exterior loud speaking telephones. This company manufactures a large number of styles of telephones and transmitters for long and short distance work, as well as magnets and extension bells, insulators, hooks, magnets, telephone switchboards, etc.

A. T. HOWARD & CO., 149 Church street, New York, in a neat 8-page pamphlet, describes and points out the merits of the various grades of B. & S. compound which they manufacture. It is claimed that this compound, of which one of the constituents is bi-sulphide of carbon, has more points of excellence than any other, odorous or odorless, on the market.

MR. JAMES W. GODFREY has resigned his position of general manager of the New York Insulated Wire Company, 15 Cortlandt street, New York. Mr. Godfrey has been with the company since 1887, and is one of the most popular and well known gentlemen in the electrical trade. Mr. F. W. Harrington, head of the sales department, is acting general manager for the present.

THE LUNKENHEIMER COMPANY, 11 East Eighth street, Cincinnati, has its 1895 catalogue already in the field. It contains 108 large, handsomely printed pages and numerous illustrations, all of which are unusually well executed—the company adhering to good wood cuts for the illustrations of its apparatus, as it does to standards of material and methods in their construction.

DAVID CHALMERS, New York agent of the Holtzer-Cabot Electric Company, 114 Liberty street, has had a complete electric plant installed in his office, and takes much pleasure in showing it to the visitors. Mr. Chalmers reports doing a large dynamo and motor business, and also in general electric supplies, and states that the Holtzer-Cabot Company (Boston) is running day and night.

CHARLES A. STRELINGER & CO., Detroit, Mich., in a catalogue of several hundred compactly printed pages containing more than 1,300 illustrations, gives descriptions and prices of every imaginable kind of hardware and mechanical supplies, steam goods, iron-working machinery, etc. Each article is accompanied by an intelligently written note referring to its particular use, merit, etc.

THE NUTTING ELECTRIC COMPANY, Chicago, has received many compliments on the efficient manner in which it has illuminated the recently completed tunnel under the Chicago River. The tunnel is 1,514 feet long and 30 feet wide—the largest single span tunnel in the world—and is illuminated by fifty 2,000-cp Nutting arc lamps, supplied from a constant potential circuit of 110 volt pressure.

THE MATHER ELECTRIC COMPANY, of Manchester, Conn, has just been awarded, through its New York contractors, Messrs. H. B. Coho & Co., the contract for three 100-kw direct connected generators of its new type, for the lighting plant of the new Congressional Library Building at Washington, D. C. Very extensive tests of this new apparatus had been made by government experts at the Manchester factory.

DEAN BROTHERS' STEAM PUMP WORKS, Indianapolis, Ind., are well represented by a catalogue of 134 pages, upon which apparently no expense has been spared. The design of the covers would grace a literary volume, and the quality of paper equals that of an art publication. Scores of forms of the Dean pump are illustrated and described, and at the end of the pamphlet some interesting "Hints on Hydraulics" and useful tables are given.

THE ELECTRIC APPLIANCE COMPANY, Chicago, reports that it is beginning its fourth business year by making some special inducements in price on the Packard transformer, which has made a great reputation for itself during the last few years for regulation and efficiency, and that it has made a big point on carrying a very large and complete transformer stock in Chicago, enabling it to make immediate shipment from that point, and thus save customers long delays in transit.

THOS. BARRACLOUGH, 20 Bucklersburg, London, England, sends us a large catalogue containing illustrations and descriptions of numerous machines used in the process of covering electric wires and cables with India rubber, gutta percha, silk, cotton, hemp, jute, tape, etc., and for stranding, core serving, sheathing, taping, wiring and compounding machinery. The machinery made by this firm seems to be absolutely inclusive of the processes relating to the art of making every kind of insulated wire and cables.

THE AUTOMATIC ELECTRICAL SPECIALTY COMPANY, of 136 Liberty street, New York, is now the New York agent for the American glazed insulating tubes and insulators. Mr. Auerbacher, of the Automatic Electrical Specialty Company, reports having made some fine sales of these insulating goods already, and is confident of an increased sale, as the tubes and insulators are claimed to be superior to porcelain. The company has opened a salesroom and office at 31 Clinton street, Newark, N.J., where a nice line of electrical supplies of every description will be kept constantly on hand. Mr. John C. Ball, formerly in the employ of The E. S. Greeley & Co., will have charge of this office.

THE INTERIOR CONDUIT AND INSULATION COMPANY calls our attention to an unfortunate typographical error in a note printed in this column last week. In referring to the very important amendment made by the New York Board of Fire Underwriters to its rules, we wrote "it has amended Rule 22 so as to permit twin conductors to be used in a complete, fully-insulated, continuous iron conduit," but as printed "prevent" was substituted for the word "permit," thus making the statement convey a meaning exactly the reverse of that intended. As the result announced is one of great importance, and only brought about after considerable effort, we regret that the typographical error should have occurred in particular connection.

THE GENERAL ELECTRIC COMPANY, on account of the increase in its electrical business, has added an extension to its already extensive facilities at Schenectady, and two large buildings are now being constructed there—a storehouse and standardizing laboratory. The storehouse is 353 feet long and 52 feet wide. The fundations are already laid and the superstructure is rising rapidly This will relieve the smaller storehouses now found entirely inadequate. The other building will be used as a laboratory for standardizing. It will be erected on the very outskirts of the tract of land owned by the company at Schenectady, in order that it may be as far away as possible from the disturbing influences of moving iron and heavy electric currents in and around the many buildings of the plant proper. This laboratory will contain all the standard instruments of the company, and with these the many working instruments in use throughout the factories for testing purposes will be compared each day.

WARREN WEBSTER & CO., Camden, N. J., specialists in examining steam plants where increased economy in fuel is desired, by utilizing the wasted exhaust steam, report considerable activity in their business, owing to the better appreciation of their manufactures in comparison with standard apparatus for similar purposes. Among the recent orders for the Webster vacuum feed water heater and purifier to be used in connection with electrical plants, they mention the following: Johnstown Electric Light Company, Johnstown, Pa., 800-hp; Warren Electric Light Company, Warren, Pa., 400-hp; Plattville Electric Light Company, Plattville, Wis., 200-hp; Jerseyville Electric Light, Gas and Power Company, Jerseyville, Ill., 350-hp; Bridgeport Electric Light and Power Company, Bridgeport, O., 250-hp; Card Electric Company, Mansfield, O., 150-hp; Worcester Electric Light Company, Worcester, Mass., 150-hp; The Falkenau Engineering Company, Philadelphia, Pa., 250-hp. In a number of the above contracts other equipments of standard makes of feed water heaters were removed. Numerous orders were also received for the Webster separators and the Williames vacuum system of steam heating.

Business Notices.

WOVEN WIRE BRUSHES.—The Belknap Motor Company, of Portland, Me., are the patentees and manufacturers of the best woven wire commutator brush on the market.

BATTERY CUT-OUT, CHEAP.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

A RAILROAD DOCTOR'S PRESCRIPTION.—General Western Agent C. K. Wilber, of the Lake Shore & Michigan Southern Railroad, with headquarters at Chicago, is, without trying, one of the really funny men of the railroad world. The other day, for example, he accomplished this advertisement, which old hands at the business truly say is one of the brightest little things ever put on paper:

R

The Lake Shoe Limited taken regularly on your Eastern trips will prevent that tired feeling so often experienced by travelers.
Leaves Chicago, V.XXX P. M.
Arrives New York, VI.XXX P. M.

C. K. WILBER.
Can be taken without shaking. W. P. A.

General Passenger Agent Daniels says that Dr. Wilber's prescription is equally efficacious on trains of the New York Central, he having this assurance from Drs. Cosby and Dumond, who have tried it with perfect success. General Passenger Agent Fee, of the Northern Pacific, has offered to all his local agents and subordinates a handsome prize in money for the best advertisement of the line, and it is obviously well for them that Mr. Wilber "isn't in it."—*Brooklyn Standard-Union.*

Illustrated Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DECEMBER 11, 1894.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

530,041. APPARATUS FOR CONTROLLING ELECTRIC ELEVATORS; N. O. Loindstrom, Union Course, and O. P. Cummings, Brooklyn, N. Y. Application filed Sept. 20, 1894. This comprises an auxiliary motor having a non-commutated armature circuit, the polar axis of the armature lying transverse to the field of force, a controlling switch on the car for reversing the armature torque, and reversing switches in the main motor circuit attached by the auxiliary motor.

530,543. CONDUIT ELECTRIC RAILWAY; D. Mason, Schenectady, N. Y. Application filed June 8, 1893. This comprises a tubular current main, an electric generator connected thereto, and means for heating and forcing liquids, vapors or gases through it.

530,575. TELEPHONE TRANSMITTER; A. F. Boardman, Somerville, Mass. Application filed Aug. 8, 1894. This comprises a support having an annular

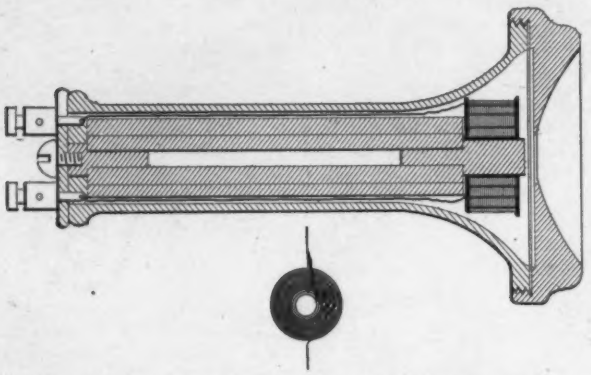
ring, and an offset, a recess in the ring under the offset, a diaphragm supported on the ring, and electrodes mounted on the offset.

530,578. ELECTRIC ELEVATOR CONTROLLER: L. S. Buffington, Minneapolis, and W. C. Jones, Chicago, Ill. Application filed Feb. 23, 1894. The combination with a laterally sliding elevator door, of means for opening the same through the agency of the weight of the door.

530,597. ALTERNATING CURRENT TRANSFORMER; A. W. Meston, St. Louis, Mo. Application filed Jan. 23, 1893. The combination with the inclosing case, of a removable mount for the coils.

530,498. INSULATOR FOR ELECTRIC OVERHEAD CONSTRUCTION; H. P. Ball, Bridgeport, Conn. Application filed June 28, 1894. A strain insulator having a flanged part in conoidal form with an elliptical base, an eye bolt with an engaging part to be inserted in the flange, and insulating material between the parts.

530,507. CONTROLLER FOR ELECTRIC LOCOMOTIVES; J. W. Darley, Jr. Application filed Nov. 16, 1893. This comprises a commutating cylinder, a



No. 530,516.—Suppression of Self-Inductance.

reversing cylinder, and mechanism adapted to permit the starting of the commutating cylinder only when the reversing cylinder is in a running position.

530,516. SUPPRESSION OF SELF-INDUCTIVE OBSTRUCTION IN ELECTRO-MAGNETS; S. D. Field, Stockbridge, Mass. Application filed July 24, 1894 This comprises an electro-magnet, an associated incomplete, electro-static shunt or inductive circuit, connected with one of its terminals, and having branches or extensions interposed between the several layers of its convolutions.

530,522. GALVANIC RING; D. Hattenback, Sioux City, Ia. Application filed Sept. 4, 1894. A metallic ring in two parts soldered together, the metals in each part forming positive and negative electrodes.

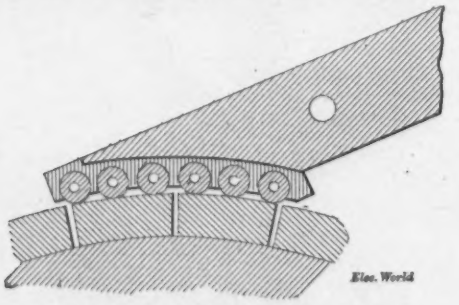
530,619. ELECTRIC MOTOR PROPELLED ELEVATOR; F. E. Herdman, Indianapolis, Ind. Application filed Jan. 31, 1893. This comprises traveling sheaves, cable wound around same, a pivoted lever to which the cable is connected, a spring acting upon the lever, a rod connected to the lever and a connection between the rod and the elevator power regulating mechanism.

530,651. RAIL BOND OR CONNECTOR; C. J. Reed, Philadelphia, Pa. Application filed Sept. 20, 1894. This consists of two separate parts screw-threaded into the ends of the rails and then twisted together, and afterward united by solder.

530,674. TROLLEY WIRE AND SUPPORT THEREFOR; H. H. Ashley, Springfield, Mass. Application filed Aug. 25, 1894. This consists of opposing cheek members with downwardly and inwardly inclined slots, end inclines, central uniting web, and webs at and uniting the upper portions of the cheek members.

530 688. CONDUIT RAILWAY TROLLEY; J. C. Hawley and W. J. Black, Dunnuoson, Pa. Application filed March 22, 1894. The combination with a depending standard of a reversible trolley-carrying bracket having a vertically moving spring actuated member.

530,706. INSULATOR; L. McCarthy, Boston, Mass. Application filed Sept.



No. 530,717.—Dynamo Brush.

18, 1894. This comprises a case with downwardly projecting skirt with perforations therein, and a mass of insulating material applied to the interior, exterior and edge of the skirt and passing through the perforations.

530,717. BRUSH FOR DYNAMO ELECTRIC MACHINES; E. T. Platt, Chicago, Ill. Application filed June 11, 1894. This comprises a commutator brush provided with a flexible body portion and a series of rolls arranged on an arc of a circle to contact at least two segments of the commutator.

530,727. RHEOSTAT. T. W. Shelton, St. Louis, Mo. Application filed Aug. 20, 1894. This comprises pairs of disks of fire clay bolted together, the disks having embedded therein convolute conductors, and conductors from the bolts to the edges of the disks.

530,748. SYSTEM OF TRANSMITTING AND DISTRIBUTING ELECTRICAL ENERGY; C. C. Chesney, Pittsfield, Mass. Application filed Aug. 19, 1894. This consists in generating three phase currents of low frequency and high tension, operating these by a motor, driving by the motor a two-phase generator adapted to yield currents of high frequency and distributing such currents to translating devices.

530,762. ELECTRICAL BLOCK SIGNAL APPARATUS; U. J. Fry, Milwaukee, Wis., and M. Basford, Oak Park, Ill. Application filed July 5, 1893. This comprises a main circuit connecting two stations, one provided with a signal and a polarized controlling magnet, and the other with a pole changing switch; a circuit breaker arranged to be opened by the operation of the switch, and a train circuit arranged to close the first circuit.

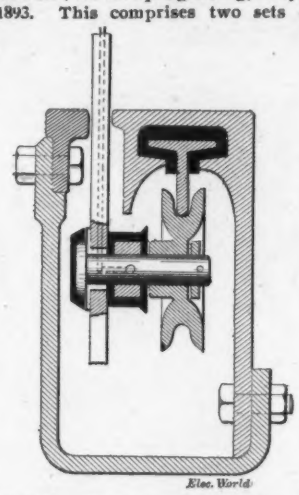
530,763. BLOCK SIGNAL APPARATUS; U. J. Fry, Milwaukee, Wis., and G. M. Basford, Oak Park, Ill. Application filed Sept. 17, 1894. This comprises main line and stations, signals, an electro-magnetic signal locking device and means of releasing the locking device of a distant station, a circuit breaker, a magnet controlling the circuit breaker, in a local circuit provided with two circuit breakers controlled by separate train circuits.

530,764. PRIMARY BATTERY; G. H. Gardner, Boston, Mass. Application filed March 12, 1894. This comprises an annular metallic contact plate moulded into the material of which the cell is composed, and adapted to form a metallic lining for that part of the cell that lies between the porous cup and the walls.

530,773. ELECTRIC MOTOR; F. E. Herdman, Winnetka, Ill. Application filed July 25, 1894. This comprises a translating device, resistances in the circuit, a controlling arm for the resistances, a device adapted to retard the controlling arm, and mechanism controlled by the translating device current to control the said retarding device.

530,798. RAILWAY SIGNAL; J. V. Richardson, Farmville, Va. Application filed March 30, 1894. This comprises a parallel line of conductors arranged in blocks, contact devices carried by the locomotive, and a signal in circuit with the conductors.

530,804. BATTERY SWITCH; H. K. Spangenberg, Leipsic, Germany. Application filed July 24, 1893. This comprises two sets of cells, a switchboard



No. 530,828.—Conduit Railway Trolley.

for regulating the number of cells in use, and a distributing board provided with means for cutting out one set of cells and for coupling the two sets of cells in series or multiple arc.

530,808. FIRE ALARM HUT; Montreal, Canada. Application filed Sept. 17, 1894. The combination of the door, door closing lever, a spring attached to the lever and a blade alongside the bottom edge of the door and having the lever passing therethrough.

530,828. CONDUIT-RAILWAY TROLLEY; W. E. Delabarre, F. McDonald Frazer, and H. A. Carrick, New York, N. Y. Application filed Jan. 26, 1894. This comprises a transmitting arm projecting through the slot of a conduit, a trolley connected to the arm, and a covering of insulating material secured to the arm, the covering being provided at its ends with bevels facing in the opposite direction from that of the trolley.

530,838. INCANDESCENT LAMP; J. R. Grove, New York, N. Y. Application filed May 26, 1893. The combination of a bulb, indepedent section of cast material closing the neck thereof and having an internal ridge for engagement with the socket.

530,847. PROCESS OF MANUFACTURING PLATES FOR SECONDARY BATTERIES; H. F. Kirkepatrick-Picard and H. Thame, London, England. Application filed Jan. 13, 1894. This consists in firing the plates admixed with oxide and sulphide of lead, the adaptation thereto when hard and cold, of semi-vulcanized India-rubber, in a plastic condition, to embrace in a solid mass without joints, the edges of the plate; the adaptation, similarly, of separate pieces to the surface of the plates, and a vulcanization of the frame and separators in situ on the plate by heat.

530,867. PRIMARY BATTERY; W. Walker, Jr., Birmingham, and F. R. Wilkins, Handsworth, Eng. Application filed June 4, 1894. A battery having a negative element of carbon forming part of the jaw containing the exciting solution, with which one surface of the carbon is in contact while the other is exposed to the atmosphere, and a saucer containing the jar and provided with a discharge.

530,882. ARC LIGHT HANGER BOARD; D. J. Cartwright, Boston, Mass. Application filed June 26, 1894. A board constructed in sections having hangers respectively attached thereto and provided with means for securing the sections at different distances apart.

530,895. INCANDESCENT ELECTRIC LAMP; E. Kaye, Monaca, Pa. Application filed Feb. 4, 1893. A lamp with a threaded neck, in combination with a removable plug and cap threaded to screw on to the neck and threaded exteriorly to screw into a lamp socket.